(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 471 090 A1**

(12) **EUROPEAN PATENT APPLICATION published in accordance with Art. 158(3) EPC**

(21) Application number: **91905327.2**

(51) Int. Cl.[5]: **G06F 15/16**

(22) Date of filing: **05.03.91**

(86) International application number:
PCT/JP91/00293

(87) International publication number:
WO 91/14230 (19.09.91 91/22)

(30) Priority: **05.03.90 JP 533/91**
30.05.90 JP 140905/90
18.06.90 JP 159362/90

(43) Date of publication of application:
19.02.92 Bulletin 92/08

(84) Designated Contracting States:
DE FR GB

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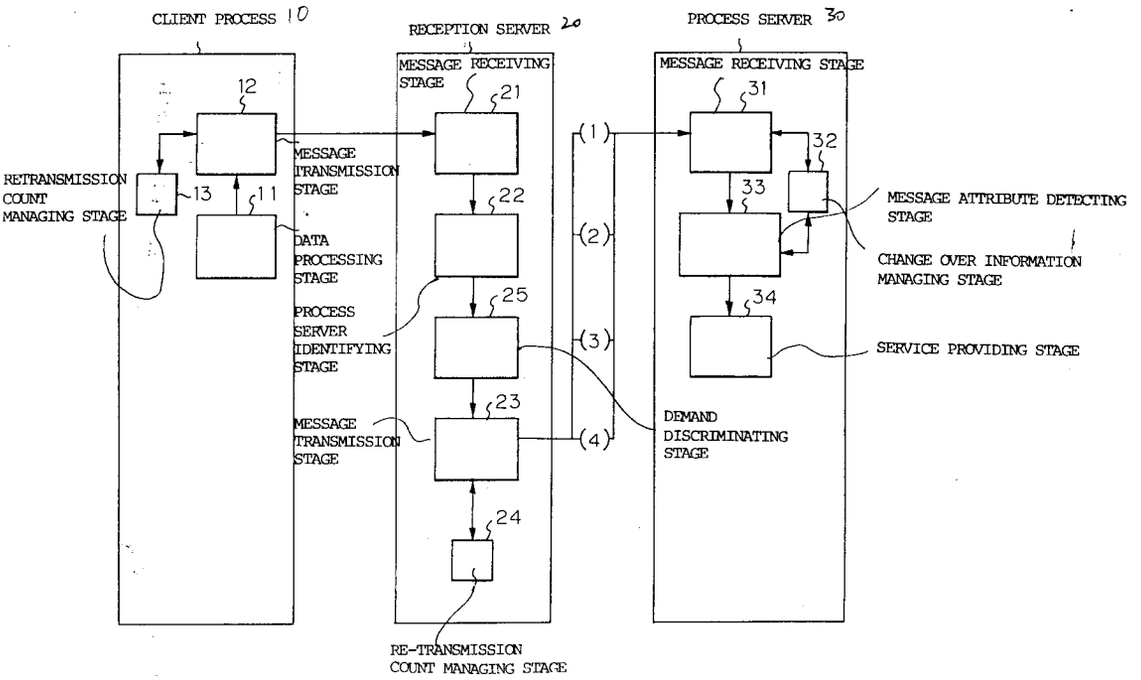
(54) **MESSAGE COMMUNICATION PROCESSING SYSTEM.**

(57) A message communication processing system in a distributed processing system, wherein a request discrimination part (25) is provided in a reception server (20) provided between a client server (10) and a processing server (30) as the basic configuration of this invention. The request discrimination part (25) discriminates between a request for only a collation processing attended by neither update of data in a medium nor exclusion of a resource and a request for both collation and update processings accompanying change of the state of a resource. Further, the request discrimination pan (25) discriminates between first, second and third request forms of the kinds of requests. A first configuration according to the invention is the one in which a client judges that a message resending processing requested through the client server (10) is normally executed in the processing server (30) when receiving a processing completion message from an issuing part (41). A second configuration is the one in which the reception server (20) specifies the processing server (30) and adds an identifier and the number of resendings added to the message from the client to a message to be transmitted to the processing server (30), and the processing server (30) holds the added identifier and the added two kinds of numbers of resendings as information to be transferred to a standby system and compares the numbers with retained values corresponding to the numbers to judge whether the transmitted message is a resending message or a redundantly transmitted message. A third request configuration is the one in which a nonvolatile storage (5) for storing a message and a message identifier added to it is provided between the in-operation system and a standby system so as to be used in common, identifier discrimination processing parts

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(200-11) for identifying the message identifier are provided in both systems, the message identifier comprises a multi-request ID, the contents of a request counter and of a resending counter, and a message added with a corresponding message identifier according to the multi-request ID and to the content of newly resent message is transmitted.

Fig. 1



FIELD OF THE INVENTION

The present invention relates to a message communication system, particularly to a message communication system in a distribution processing system establishing a network through a plurality of nodes for message communication between a client in one node and a server in another node, between servers in different nodes and between servers in the same node.

BACKGROUND ART

In recent years, distribution processing systems establishing networks with a plurality of nodes is the expanding in various fields. One example is the use of LAN (local area network). Each node is composed of a processor, memory and so forth and connected through an optical fiber and so forth to form a network. The distributed processing system is intended to provide a higher process speed by distributed processing of message between nodes or through the processors in respective nodes.

In the distributed processing system, there is a possibility of occurrence of server crashing due to failure of hardware or software during message communications between a client in one node and a server in another node or between servers in the same node.

In general, as a back-up for the server crashing caused by failure of the hardware, another stand-by system is provided in addition to a current system. Upon occurrence of the server crushing in the current system, the stand-by system instantly takes over the operation for preventing system down.

On the other hand, the only solution for the server crashing caused by failure of software in the prior art is to find bugs in the program for manual correction, and during this period, the stand-by system is unavoidably used.

DISCLOSURE OF THE INVENTION

It is one object of the invention to realize a back-up with small overhead for server crash originated from the software problem, in message communications between a client in one node and a server in another node, between servers in different nodes and between servers in the same nodes.

Another object of the present invention is to effectively discriminate whether the received message is a re-transmitted message or redundantly transmitted message in a processing server, when a reception server which receives a service demand from a client in message communication between the client in one node and the server in another node, calls for a service to a client for the processing server which serves as service provider.

A further object of the present invention is to prevent messages from dropping out and detect redundant transmission by storing a message identifier in a non-volatile memory in the message communication between the client in one node and the server in another node, and by enabling a stand-by system to perform re-transmission of message with an identifier indicative of the fact that the message is re-transmitted, in place of the current system with reference to the message identifier stored in the non-volatile member, upon occurrence of down of transmission side current.

In order to accomplish above-mentioned objects, the following inventions are proposed.

According to the basic aspect of the invention, a message communication processing in a distributed processing system, comprises a client server, a processing server and a reception server including a demand discrimination means, the demand discrimination means distinguishing a demand only for processing of reference and not associated with updating the medium or exclusiveness of resources, and a demand for a reference process and reference and updating process associated with a change of state of the resource.

According to the first aspect of the invention, the processing server comprises a discrimination stage for discriminating whether the process for the message transmitted from the client has already been completed or not, a demand processing stage for performing a process for the message from the client when the discriminating stage makes the judgement that the process is not completed, a writing stage for writing the results of the process performed in the demand processing stage to a non-volatile memory, and an issuing stage for issuing a notice that the process has already been completed when the process has been completed in the discrimination stage and a notice that the process at the demand processing stage is normally completed when it is determined that the process is not completed, the client considers it normal when the notice that the process has already been completed, when a re-transmission process for the message is performed.

According to another aspect of the invention, the reception server is provided between the client server and a plurality of processing servers, the reception server identifies a processing server which becomes a service provider for the service demand, and demands provision of the service for the identified processing server, the reception server adds an identifier and a re-transmission count added to the message from the client to the message to be transmitted to the process server, and the process server holds the identifier and two

kinds of re-transmission counts as change over information for a stand-by system, the processing server performing a comparison for the two kinds of re-transmission counts with the held values corresponding to the re-transmission count to discriminate whether the message is a re-transmitted message or a redundantly transmitted message. The process in the comparison is performed in such a manner that, when the re-transmission count is greater than the corresponding held value, it is determined to be a re-transmitted message, when smaller, it is considered a redundantly transmitted message, and when equal, further comparison is made for the re-transmission count added to the message by the reception server with the corresponding held value determining that it is a re-transmitted message when greater and a redundantly transmitted message when smaller or equal.

According to a further aspect of the invention, for the system including a stand-by system in addition to a current system, a non-volatile memory for storing the message and the message identifier, is provided in common with the current system and the stand-by system, and for the current system and the stand-by system, an identifier discrimination stage for discriminating whether the message identifier is the same or difference, proceeds. The message identifier comprises a multi demand ID, a content of a demand counter and a content of a re-transmission counter; the multi demand ID and message identifier corresponding to the contend of new and re-transmission, are added when the message is transmitted.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing basic construction of the present invention;
Fig. 2 is a basic block diagram showing the first aspect of the invention:
Fig. 3 is an exemplary block diagram of software structure for implementing the first aspect;
Fig. 4 is a flowchart showing process executed in a server in the first aspect;
Fig. 5 is a flowchart showing process executed in a client in the first aspect;
Fig. 6 is an explanatory illustration of the process of message communication in the first aspect;
Figs. 7A and 7B are block diagrams showing a distributed processing system;
Figs. 8A and 8B are flowchart showing a process in the prior art;
Figs, 9A and 9B are explanatory illustrations showing the process in the prior art;
Fig. 10 is a basic block diagram of the second aspect of the present invention;
Fig. 11 is a block diagram showing construction of the distributed processing system in the second aspect;
Fig. 12 is a flowchart showing the process executed in the client in the second aspect;
Fig. 13 is a flowchart showing the process executed by each file managing server in the second aspect;
Fig. 14 is a flowchart showing the process executed by a file source managing server in the second aspect;
Fig. 15 is an explanatory illustration of the basic process in the second aspect;
Fig. 16 is a schematic illustration showing communication between the client and the server in the second aspect;
Fig. 18 is an explanatory illustration showing a non-volatile memory between the client and server in the second aspect;
Fig. 19 is a basic block diagram of the third aspect of the present invention;
Fig. 20 is an explanatory illustration showing a message identifier in the third aspect;
Fig. 21 is a exemplary block diagram in the software in the third aspect of the invention;
Fig. 22 is a flowchart showing a message transmission process in a transmission side server in the normal process in the third aspect;
Fig. 23 is a flowchart showing a message re-transmission process after re-starting of a transmission side server, in the third aspect; and
Fig. 24 is a flowchart showing a message receiving process at a receiving side server in the third aspect.

BEST MODE FOR IMPLEMENTING THE INVENTION

Fig. 1 is a constructional illustration showing the basic structure of the present invention. As shown, the system is constructed by arranging a reception server 20 between a client process 10, a processing server 30. A data processing stage 11, a message transmitting stage 12 and a re-transmission count managing stage 13 are provided in the client process 10. The reception server 20 includes a message receiving stage 21, a processing server identifying stage 22, a message transmission state 23, a re-transmission count managing stage 24 and a demand discrimination stage 25. On the other hand, the processing server 30 includes a message receiving stage 31, a take over information managing stage, a message attribute detecting stage 33 and a service providing stage 34.

In the basic construction of the invention, the demand discrimination stage 25 is provided in the message reception server 20. The message discrimination stage classifies a respective message communication system in first, second and third

aspects which will be discussed later. Namely, according to the type of demand, each system is selected. Order for selection is following (1), (2), (3), (4). With this, the necessary overhead can be minimized. As is clear from the following discussion, (2) corresponds to the first aspect, (3) corresponds to the second aspect, and (4) corresponds to the third aspect.

(1) This type is for a reference type demand which does not require updating of a medium or exclusive state of a source. In this case, only a re-transmission system is used and no overhead exists. This case will not be discussed in the present invention.

(2) This type is an updating type demand but can be processed without requiring knowledge of re-transmission or redundant transmission. In this type, the demandant can determine the result of the process, such as completion of process. Here, conscious for re-transmission or redundant transmission means detection of the demand for re-transmission or redundant transmission and abandoning the demand regarding the re-demanding as normal. This type occurs in communication between servers. In the following discussion for the first aspect in the present invention, the process content is stored in the non-volatile memory only at the processing server.

(3) This type is for the process of the processing server for guarantee of the function viewed from the client. In this case, the reception server only identifies the processing server. In the later discussion of the second aspect of the present invention, it is similar to the above-mentioned (2) at the point that the content of the process is stored in the non-volatile memory only at the processing server. However, the addition of a unique re-transmission count is done in the reception server. The process for guaranteeing the function, means the process for completely achieving generation.

(4) This type is for the process of the reception server for guaranteeing the function as viewed from the side of the client. In this case, the reception server demands a process for the processing server as if the processing server operates as parts. In the later mentioned the third type process, the content of the process is stored in the non-volatile memory at both the reception server and the processing server.

The process performed by the demand discrimination stage 25 will be discussed herebelow. In the drawings, (1) to (4) corresponds to (1) to (4) set forth above.

When demand is for the process of (1), no process is performed, since it is a demand only for reference.

When demand is for the process (2), no process is performed since a process can be made without being conscious of re-transmission or redundant transmission and the demandant may determine the result of the process, such as process completion or so forth, as set forth above even though the demanded process is for updating.

When demand is for process (3), a re-transmission counter is established between the client and reception server and between the reception server and the processing server. Also, a message identifier for identifying the message from the client is set.

When demand is for the process (4), as will be discussed later with respect to the third aspect, multiple demand ID is assigned for the identifier to definitely set the message identifier. The message identifier consists of the multiple demand ID, the demand counter and re-transmission counter. This is used between the reception server and the processing server. At the reception server, for providing a back-up for crushing in the reception server, the content of the transmitted message is transferred to the non-volatile memory.

Hereafter, discussion will be given for the first aspect according to the invention.

As shown in Fig. 7A and 7B, discussion will be given for the distributed process system, in which nodes 1 each having a processor 3, a non-volatile memory 5, and communication device 6, are connected through a network 2. In such a system, exchange of information between the nodes 1 is done by way of message communication.

Figs. 8A and 8B are flowcharts showing the conventional process. Fig. 8A is a message transmission process executed by the client. Fig. 8B is a message reception process executed by the server.

In message communication, there are delay and random order of the message, problems in general. Namely, a message can be delayed for a random period and can be lost. On the other hand, the order of transmission at the transmission side and the order of reception at the receiving side are generally not consistent with each other.

As a solution for such problems, the following method has been applied in the prior art. Hereafter, discussion for an exemplary process in the case wherein the client in one node 1 demands a serve process in a different node 1 by a message.

(a) Solution for Delay of Message

Client will transmit a message again when a response message from the server cannot be received even if a certain period elapseds. Namely, re-transmission of message is performed.

(b) Solution for Random Order of Message

The client gives demand ID's for a message for every demand for the server in incremental order. Giving demand ID's in incremental order means that when re-transmission is performed the same demand ID is used, and after receiving a response from the server, a demand ID incremented by "1" is used for the next transmission of the demand message. On the other hand, the server manages the demand ID with respect to each of the demands and selects the message according to the following protocol.

(1) If "managing demand ID" = "new demand ID transmitted from the client", the message from the client is a re-transmitted one. Therefore, for the client, only the result of the process is noticed.

(2) If "managing demand ID" > "new demand ID transmitted from the client, the message from the client is a delayed re-transmitted message. Therefore, it is ignored.

(3) If "managing demand ID" < "new demand ID transmitted from the client", the message from the client is a new demand. Then, the demand is processed and the response message is transmitted to the client. Also, the "managing demand ID is reset by the "new demand ID transmitted from the client.

In the message communication performing the process set forth above, when the crushing is caused at the node 1 where the client exists, in order to realize a fault tolerant (FT) approach, the client is capable of writing the demand ID in the non-volatile memory to guarantee incrementality of the demand ID, and takes a method for updating the content thereof on every occasion of issuing a demand for the server. Once, crushing is caused, the information is recovered to a volatile memory 4 and restored to a condition having no inconsistency to restart issuance of the demand. Here, the fault tolerant is an approach for withstanding the fault by positively employing the redundant design.

On the other hand, when the crushing is caused at the node 1 where the serves exist, in order to realize a fault tolerant (FT) approach, the construction is employed to write the demand ID transmitted from the client in the non-volatile memory and is taken to update the content every time the new demand ID arrives. At this time, in order to conceal the influence of server crushing from the sight of the client, the result of the process in response to the message and the information necessary for restoring the environment that the server manages, are also written in the non-volatile memory. Once crushing occurs, the information is recalled to the volatile memory 4 and restored to a state having no inconsistency, reception of the demand is resumed.

Fig. 9A and 9B shows an explanatory illustration of the process in the prior art. Here, Fig. 9A illustrates a recovery processbe taken place at the occurrence of crushing at the client. Fig. 9A shows the recovery process when the crushing is caused at the server.

However, in such a prior art, as can be clear from the flowchart of Fig. 8B, the server has to write the demand ID given to the message in addition to the result of process (including the information required for restoring the environment for management of the server). As is well known, accessing for the non-volatile memory 5 requires a much longer period than that for accessing the volatile memory. By this, a problem is encountered in the overhead for dealing with the server crushing.

The first type of process of the present invention has an object in view of the problem set forth above, to provide a novel message communication system which can deal with the server crushing with small overhead.

Fig. 2 is a basic block diagram of the first aspect of the present invention.

In the drawings, the reference numeral 10 denotes a client belonging in a different node of the distributed processing system and demands a service for a server 10. The reference numeral 30 denotes a server in a certain node in the distributed processing system and provides a specific service. The reference numeral 40 denotes a message communication control section for controlling message communication between the server 30 and the client 10.

The server 30 comprises a demand processing stage 35, a volatile memory 36, a discrimination stage 37, a writing stage 38, a non-volatile memory 39, a recovery stage 40 and a notification stage 41. The demand processing stage 35 processes the service demand from the client 10. The volatile memory 36 stores the result of process in the demand processing stage 35. The discrimination stage 37 discriminates whether the service demand from the client 10 is completed or not on the basis of the stored data in the volatile memory 36. The write stage 38 writes in the results of the process to the non-volatile memory 39. The non-volatile memory 39 maintains the written results of process even when crushing occurs. The recovery stage 40 recalls the results of the process maintained in the non-volatile memory 39 to the volatile memory 36 upon resumption of the crushing. The notification stage 41 issues a notice for the process being completed when it is determined that the process is completed, and issues a notice for normal completion of the demand processing stage 35 for the client 10 when it is determined that the process is

not yet completed.

The client terminates re-transmission of the message when it is determined that the process is successfully terminated according to the discrimination process performed by the discrimination stage 14 for discriminating the content of the notice.

As set forth, according to the first aspect of the present invention, the server 30 performs the process so as not to write the demand ID to the non-volatile memory and thus can reduce the frequency of accessing the non-volatile memory 39. Therefore, it can realize a smaller overhead for dealing with the server crush.

An embodiment of the first type of process according to the present invention will be discussed in detail, hereafter.

Fig. 3 shows one embodiment of the software construction for realizing the first aspect of the invention.

In the drawing, the same element as that discussed with respect to Fig. 2 will be represented by the same reference numerals. The reference numeral 301 denotes a server message communication processing stage incorporated in the server 30 and performs a control for message communication with the client 10. The reference numeral 302 denotes a server demand processing stage in the server 3, and performs a service process demanded through the message communication from the client. The reference numeral 15 denotes a volatile memory provided in the client 10, and manages the demand ID to be added to the message and transmitted to the server. The reference numeral 16 denotes a non-volatile member in the client for storing the demand ID identical to that stored in the volatile memory 15 in a non-volatile fashion so as to deal with the crushing at the client. The reference numeral 100-10 denotes a client message communication processing stage and performs a control of the message communication with the server 30. The reference numeral 50 denotes a message communication authority managing stage which provides authority for the client to perform message transmission for the server 30.

The client message communication processing stage 100-01 increments the demand ID in the volatile memory 15 and incremented demand ID is stored in the volatile memory 25, and then transmits the message to the server 30 by adding the incremented demand ID, when a new message is to be transmitted to the server 30. When a response from the server 30 cannot be received even after expiration of the predetermined period, the retransmission of the transmitting message with the same demand ID is performed. The client message communication processing stage 100-10 thus processes to perform the serializing process in the message transmission through the process set forth above. Then, if client crushing is caused, the demand ID maintained in the non-volatile memory 16 is recalled in the volatile memory upon resumption of the crushing, to process for continuation of the serializing process in the message communication.

Next, Fig. 4 is a flowchart showing a process to be executed by the server in the first type of process. Discussion will be given for the process when the message from the client 10 is received.

When the message from the client is received, the server 30, initially performs a checking whether the demanded process from the client 10 has been completed or not by making reference to the volatile memory 36, as show in the step 1 of the flowchart of Fig. 4. According to the checking process at the step 1, if it is determined that the demanded process has already been completed, the process is advanced to step 2 to issue a notice notifying that the process has already been completed for the client 10. On the other hand, when it is determined that the demanded process is not yet processed according to the checking process of the step 1, the process is advanced to step 3, in which the demanded process is performed (executed by the server demand processing stage 302), then, at step 4, the result of the process is written in the non-volatile memory for dealing with the server crushing. Subsequently, at step 5, a notice for norma, completion is issued to the client 10. Once the server crushing occurs, upon resumption of the crushing, the process is performed to realize continuation of the process of message reception by recalling the management data of the result of the process maintained in the non-volatile memory 39 to the volatile memory 36.

Fig. 5 is a flowchart of the process executed by the client in the first aspect. Discussion will be provided for the process in the client when the notice indicating that the process has already been completed or the process has been normally completed. The client 10 processes to determine as normal similar to reception of the notice of normal completion when the notice that the process has already been done, is received.

Fig. 6 is an explanatory diagram showing process of the message communication in the first aspect. As shown, when the process "asn A" for assigning a resource A is normally processed, if the "asn A" with the same demand ID is retransmitted, the notice indicative of the done process is issued. Even when "ans A" with a different demand ID due to program error or so forth, is transmitted, the process is performed to issue the notice of done process.

As set forth above, according to the first aspect of the invention, since it becomes unnecessary to

write the demand ID every time it receives new demands from the client, the overhead for realizing the server crush can be significantly reduced.

Second aspect will be discussed herebelow.

In the prior art, when data processing is executed though message communication between application programs, if response to the transmitted message is absent, a decision is made whether the application program is down in the destination. By this, when data processing is executed based on the message communication, the prior art takes the architecture to cause abnormal termination if the response to the message is absent.

However, when the destination of transmission of the message is a grovel service program which runs within a specific space in the system and encloses the system resource within the space to control the resource in the whole system, in order to prevent the service from being interrupted, the current system and the stand-by system are provided so that fault toleration can be established by operating the stand-by system taking over the process when the current system is down. Therefore, at the transmitter of the message, it should re-transmit the message because there is no possibility for the occurrence of system down even when no response to the transmitted message is received in the case when the destination of the message is the grovel service program.

Fig. 16 is a diagrammatic illustration of the client and server for discussion of the second aspect of the invention. Fig. 17 is an explanatory illustration of the non-volatile memory between the client and server. Fig. 18 is an explanatory illustration of the non-volatile memory between the servers. In Fig. 16, shows the process of data processing by the client process 10, a first server 30a for receiving the service providing a demand from the client process 10 and a second server 30b which receives the service providing a demand from the first server 30a. In this case, the first and second servers 30a and 30b form the grovel service program. If crushing is caused at the first server 30a as the destination of transmission of the message, the client process 10 re-transmits the message for the new current system server 30a which takes over the process, as shown in Fig. 17. On the other hand, when the crushing is caused at the first server 30a as the transmitter of the message, the new current first server 30a which takes over the process, re-transmits the message to the second server 30b. If crushing is caused on the server 30b after transmission of the message from the server 30a to the server 30b, the server 30a returns the message to new second server 30b. Here, in the drawing, FSS represents a non-volatile specific memory area to be written in the information necessary for changing over the process from the current system to the stand-by system.

In such construction of data processing, it becomes necessary to discriminate whether the transmitted message is for a new demand, re-transmitted demand or redundantly transmitted message. If the message is for a new demand, the demanded process has to be performed. In case of the re-transmitted message, judgement has to be made whether the demanded process has already been completed or not. On the other hand, in case of the redundantly transmitted message, since the process has already been performed, no process should be performed. From this, when fault toleration is to be established by re-transmission of the message, it becomes necessary to proceed with a process for detecting re-transmitted and redundant messages at the receiver side.

On the other hand, when the first server 30a is designed so as to perform a process in which a resource is maintained therein, the received demand information has to be recorded in FSS for back-up in case of occurrence of the crushing. However, when the first server 30a performs the process in which no resource is maintained, it becomes unnecessary to store the demand information in FSS by dealing with all demands transmitted from the client process 10 as new demands.

As is clear from this, it is unnecessary to apply the algorithm for detecting re-transmitted and redundant messages which are applicable for the process of a leaving resource, for the process of the first server 30a, in which no resource should be maintained. Rather, if the same algorithm is applied, it may create the problem in that an unnecessary memory area of FSS is reserved and an unnecessary detection process for the re-transmitted message and redundantly transmitted message has to be performed to degrade the performance.

The second aspect of the invention has been established in view of the technical background as set forth above. The second aspect is intended to provide a novel message attribute detection system which can effectively detect the re-transmitted and redundant message from the process servers, in a data processing system which comprises a reception server for receiving the service demand from the client process and a plurality of process servers for providing service for the client process, and in which the reception server identifies the process server operating as service provider to demand for providing a service to the client process.

Fig. 10 shows the basic diagram of the second aspect of the invention.

In the drawing, the reference numeral 10 denotes the client process which performs predetermined data processing with a receiving service. The reference numeral 20 denotes the reception

server which receives the service demand from the client process 10. The reference numeral 30 denotes a plurality of process servers, each of which provides a predetermined service for the client process 10.

The client process 10 comprises a data processing stage 11, a message transmitting stage 12 and a re-transmission count managing stage 13. The message transmitting stage 12 is responsive to the service demand issued from the data processing stage 11 to transmit the service demand message to the reception server 20. At this time, in the message transmitted, an identifier for identifying the message and a re-transmission count value of a representative of the rate of occurrence of re-transmission are added. The re-transmission count managing stage 13 manages the re-transmission count value correlating with the message identifier.

The reception server 20 comprises the message receiving stage 21, a processing server identifying stage 22, a message transmitting stage 23 and a re-transmission count managing stage 24. The message receiving stage 21 receives the service demand message from the client process 10. The processing server identifying stage 22 identifies the process server 30 which becomes a service provider for the service required in the received service demand message. At this time, the transmitted message increases the identifier and a re-transmission count value is added to the message transmitted from the client process, and a re-transmitted count value (b) representative of the rate of occurrence of re-transmission from the reception server 20. The re-transmission count managing stage 24 manages this re-transmission count value b in correlation with the message identifier.

As set forth above, the reception server 20 performs a process for identifying the processing server 30 which can be a service provider for the service required in the client process 10. Therefore, the process is not executed in a manner to maintain the information, such as writing information on a disk and so forth. From this, the reception server 20 takes the architecture for dealing service demand messages transmitted from the client process 10 as new demands irrespective of re-transmitted messages and redundantly transmitted messages and thus neglects storing the information for changing over the process.

The process server 30 includes a message receiving stage 31, a change over information managing stage 32, a message attribute detecting stage 33, a service providing stage. In the message receiving stage 31, the service demand message transmitted from the reception server is received. The change over information managing stage 33 maintains information, such as the identifier and two kinds of re-transmission count values a and b and so forth added to the received message as changing over information, in a non-volatile fashion. The message attribute detecting stage 33 compares the identifier added to the received message with the identifier stored in the change over information managing stage 32 to discriminate whether the received message is for a new demand or not. When the received demand is not new, discrimination is made whether the received message is a re-transmitted message or the redundantly transmitted message by comparing the re-transmission count values (a) and (b) which are provided for the received message, with the corresponding held value in the change over information managing stage 32, which is recalled in the volatile memory. The service providing stage 34 performs the process for proving the service for the client process in response to the result of detection of the message attribute detecting stage 33.

In the second aspect of the present invention, the message attribute detecting stage 33 process server 30, initially makes a discrimination whether the identifier given to the received message is stored in the change over information managing stage 32. By this discrimination process, if discrimination is made that the identifier is not stored, judgement is made that the received message is for a new service demand. On the other hand, when discrimination is made that the identifier has already been stored, then, subsequent discrimination is performed to determine whether the re-transmission count value (a) given for the received message is greater the stored value held in the change over information managing stage 32, or smaller.

The message attribute detecting stage 33 decides whether the received message is a re-transmitted message when the re-transmission count value (a) of the received message is greater than the stored value. On the other hand, when the re-transmission count value (a) is smaller than the stored value, then it is decided that the received message is a redundantly transmitted message. When the re-transmitted count value equals the stored value and is detected, discrimination is performed whether the re-transmission count value (b) of the received message is greater or smaller than the stored value held in the change over information managing stage 32.

Through this process, the message attribute detecting stage 33 determines that the received message is a re-transmitted message when the re-transmission count value (b) is greater than the stored value, and that the received message is a redundantly transmitted message when it is smaller than or equal to the stored value.

As set forth above, in the second aspect of the present invention, in view of the characteristics of

the process in which the server 20 will not leave the resource, the reception server 20 deals with all of the service demand messages transmitted from the client process 10 as new demands, and thus will not make a discrimination whether the message is a re-transmitted or a redundantly transmitted. Also, recording the change over information for FSS is neglected. The processing server 30 takes the architecture to make discrimination whether the received message is a re-transmitted message or a redundantly transmitted message based on the two kinds of the re-transmission count values (a) and (b) of the transmitted message. Therefore, it is possible to effectively detect the re-transmitted messages and the redundantly transmitted messages with reduced dynamic steps and with reduced memory capacity.

Hereafter one embodiment of the second aspect of to the invention will be discussed in detail.

Fig. 11 shows the structure of the distributed process system applicable to the second aspect of the invention. In Fig. 10, the reference numeral 10 denotes the client process discussed with respect to Fig. 10. The reference numeral 20x denotes a file name managing server which manages file names and correlation of the file names and the values in which the files exist, for all of the files in the system. The reference numeral 30x denotes a file resource managing server corresponding to each volume, which performs a managing process for a file resource, such as issuance process of a handling right for using a file in the volume. The file name managing server 20a and the file resource managing server 30x are provided in the current system and stand-by system in view of crushing. Though it is neglected in the drawings, the file resource managing server 30x is provided with the above-mentioned FSS as a special storage area for storing the information necessary for changing over the process to the stand-by system.

As shown, the client process 10 receives the demand message for authorization for handling the file with respect to the file name managing server 20x. The file name managing server 20x is responsive to this message to identify the volume where the file demanded to obtain handling authority exists, and transmit a demand message for issuance of authority for handling the file for the file resource managing server 30x, which manages the file handling authority of the identified volume. When this message is received, the file resource managing server 30x issues a capability ("cap" in the drawings) of the file handling authority for the file name managing server 20x. The file name managing server 20x assigns this capability of the file handling authority to the client process 10. Once the file handling authority is obtained, the client process 10 performs a process to directly demand the opening of the exclusively obtained file resource (α in the drawing) directed by the assigned capability and the demand for a reference process.

In such process, the client process 10 performs a process for re-transmitting a demand message for obtaining a file handling authority in view of possible occurrence of crushing of the file name managing server 20x and taking over the process by the stand-by system. Also, the file name managing server 20x re-transmits the demand message for issuance of the authority for handling the file, in view of the possible occurrence of crushing of the file resource managing server and take over of the process by the stand-by system. Therefore, the file resource managing server 30x needs to have a means for detecting the re-transmitted message and a means for detecting the redundant message for the performed process transmitted with delay for the same reason.

Fig. 12 is a flowchart of the process executed by the client in the second aspect of the invention. Fig. 13 is a flowchart of the process executed by the file name managing server. Fig. 14 is a flowchart of the process executed by the file resource managing server. According to the flowcharts of Figs. 12 to 14, a detailed discussion will be given for the detecting process for the re-transmitted and redundant messages in the second aspect of the invention.

The client process 10 transmits demand messages for obtaining a file handling authority to the file name server 20x, as shown in the step 10 of the flowchart of Fig. 12. At this time, the client process 10 sequentially adds the message ID and also adds the re-transmission count value (number of re-transmission as discussed in Fig. 10). Subsequently, at step 11, when the transmitted message has not reached or the file name managing server 20z is crushing, and is detected by the message server which is not shown, at step 12, the client process 10 performs a process to increment a count value of a counter which manages the number of re-transmissions and transmits the demand message for obtaining the file handling authority.

Fig. 15 is an explanatory illustration showing the basic process in the second aspect of the invention. As shown, in the message transmitted from the client process 10 to the file name managing server 20x, the message ID and the re-transmission count value (a) are added.

When the demand message for obtaining the file handling authority is received, the file name managing server 20x instantly advances the process to step 21 without detecting the re-transmission or redundant transmission, to identify the volume where the designated file exists. Then, at step 22, a demand message for issuance of the file handling authority is transmitted to the file resource

managing server 30x which manages the file handling authority of the identified volume. At this time, the file name managing server 20x adds the message ID and the re-transmission count value (a) transmitted from the client process 10 and adds the re-transmission count value (b) number of re-transmission (b) as discussed in Fig. 10).

Subsequently, at a step 23, with respect to the message transmission process, if the message has not reached or crushing is occurring at the file resource managing server 30x and is detected by the message server, which is not shown, then the re-transmission count value of a counter, which manages the number of re-transmissions is incremented (the re-transmission count value (b) is incremented) at step 24. Thereafter, the process returns to step 22 to again transmit the demand message to issue the file handling authority to the file resource server, again. On the other hand, when reaching the message is confirmed at step 23, a process for responding to the message is performed for the client process 10, at step 25.

Through this, as shown in Fig. 15, in the message transmitted from the file name managing server 20a to the file resource managing server 30x the re-transmission count value (b) representing the number of message re-transmissions is added in addition to the message ID and the re-transmission count value (a) is transmitted from the client process 10.

The file resource managing server 30x receives the demand message for the issuance of the file handling authority from the file name managing server 20x. The discrimination as shown in the step 31 of the flowchart of Fig. 14, is made whether the file handling authority having the same message ID has already been registered or not. As shown in Fig. 15, this discrimination process is performed by searching the stored information of FSS which is recalled in the volatile memory. When it is determined that the file handing authority has not yet been registered for the transmitted message ID according to the discrimination process, then the process is advanced to step 32 to perform a new demand process. Then, at step 33, an exclusive file is obtained and a resource is established. At step 34, an area in the FSS is reserved for writing restoration information. Then, at step 35, the message ID, the re-transmission count value (a) and the re-transmission count value (b) of the transmitted message are written in the reserves area in the FSS. Also, other information which becomes necessary for restoration is written in. Once the file handing authority is obtained through the process set forth above, the file resource managing server 30x performs a process for providing capability for the client process 10 via the file name managing server 20x, as shown in Fig. 15.

On the other hand, according to the discrimination process at the step 31, when it is determined than the file handling authority for the transmitted message ID has already been registered, the process is advanced to step 36, and discrimination is made whether the re-transmission count value (a) is greater than the re-transmission count (a) set with the file handling authority or not. If greater, it is determined that the message has been re-transmitted. On the other hand, when discrimination at step 36 shows that the re-transmission count value (a) is not greater than the set re-transmission count, then, the process is advanced to step 37 to discriminate whether the re-transmission count value (a) of the current transmission is smaller than the re-transmission count (a) set with respect to the file handling authority, or not. If smaller, it is determined that the received message is a redundantly transmitted message. On the other hand, at step 37, if the transmitted re-transmission count value (a) is equal to the re-transmission count (a) set with respect to the file handling authority, then, the process is advanced to step 38, in which a discrimination is made whether the re-transmission count value (b) is greater than the re-transmission count (b) set with respect to the file handling authority. If greater, it is determined that the message is re-transmitted. Otherwise, equal or smaller, it is determined that the received message is a redundantly transmitted message.

The file resource managing server 30x terminates the process without conducting a process since the process has already been performed, when the judgement is made that the message is the redundantly transmission one. On the other hand, if it is determined that the message is re-transmitted, the process is advanced to step 39 to update the re-transmission counts (a) and (b) stored in the FSS by re-writing. Subsequently, at step 40, a process corresponding to the re-transmitted message is performed. Namely, the process is conducted as potentially the same process that has already been performed. When it is confirmed that the same process has been performed, the process is terminated. On the other hand, when it is confirmed that the same process has not yet been performed, the process is continued.

Through the process set forth above in the second aspect of the invention, since the fine name managing server is not necessary to make a judgement of the re-transmission and redundant transmission, the file handling authority can be provided for the client process 10 at high speed.

As set forth above, by employing the second aspect of the invention in the data processing process in which the client process makes a call for the reception server, and the reception server makes a call for the processing server, and in the

case that the reception server will not leave the resource, the re-transmission and redundant transmission processing adapted for such process can be realized. By this, the re-transmitted message and the redundantly transmitted message can be effectively detected with reduced dynamic steps and with reduced memory capacity.

The third aspect of the invention will be discussed herebelow. In the prior art, when the message communication is used as a communication means between programs, if the program as the destination of the message is a service program which runs in a specific space in the system and encloses the system resource to control the overall resource of the system, namely, the global service (GS), a message drop out has been prevented by using a automatic message re-transmitting function. Here, the automatic message re-transmitting function is a function to perform a re-transmission of the message when the current GS as the destination of the message, namely the current GS at the receiver side, is down, after the stand-by GS is re-started.

The GS at the receiver side stores the message identifier in the non-volatile memory every time the message is re-transmitted, and compares the message identifier of the newly received message with the stored message to distinguish the new message from the re-transmitted message.

In the present invention, the current GS and the stand-by GS are regarded as single GS. Also, when the current GS is down, the stand-by GS takes over the process.

However, in the conventional system, since the message identifier has not been stored in a form commonly used by the current GS and the stand-by GS, when a down system occurs at the message transmitter side, the message identifier used for transmitting the message can be lost and the stand-by system which takes over the process, transmits the message by adding the message identifier which is different from that transmitted from the current system.

Therefore, the conventional system encounters a drawback, in that, when the transmitter side GS is re-started, namely the re-transmitted message transmitted by the transmitter side stand-by GS, the receiver side GS cannot recognize the re-transmitted demand and can possibly cause loss of the message or redundant transmissions.

The third aspect of the invention is indented to solve the above-mentioned drawback. Particularly, the object of the third aspect of the invention is to assure prevention of loss of the message and detection of redundant transmissions between GS which uses a multi demand ID and re-transmission counter, by that the stand-by GS makes a reference to the content, such as a message identifier, stored in the non-volatile memory to add an identifier indicative of re-transmission of the message when the transmitter side current GS is down, for preventing loss of the message and detecting redundant transmissions.

Fig. 19 is a basic diagram of the third aspect of the invention. Fig. 20 is an explanatory illustration of the message identifier in the third aspect.

In the drawings, the reference numeral 100 denotes a current system. In the normal state, the content of the message communication is received from the current system. Particularly, in the case that the program as the destination of the message is above-mentioned GS, the message communication is performed by adding the message identifier as discussed later. The reference numeral 10-1 denotes a processor, which belongs in the current system 100. The reference numeral 100-2 denotes a main memory, which belongs in the current system. The reference numeral 200 denotes a stand-by system, which takes over the process in place of the current system when the current system is down. The reference numeral 200-1 denotes a processor that belongs in the stand-by system. The reference numeral 200-2 denotes a main memory, which belongs in the stand-by system. The reference numerals 100-11 and 200-11 denotes an identifier discrimination processing stage that discriminates whether the message identifier is the same or different. The reference numeral 5 denotes the non-volatile memory which can be commonly accessed by the current system 100 and the stand-by system 200. When the destination program to send the message is GS, the non-volatile memory 5 stores the content of the later discussed message identifier in conjunction with the content of the message to be communicated. The reference numeral 50 denotes the message communication control stage. When the current system 100 is down and the stand-by system 200 initiates operation, communication is normally performed by using an automatic re-transmission function for the message provided by a supervisor. However, when the destination program sent to the message is GS, the message automatic re-transmission function is not used and re-transmission of the message is performed by the logic between the GS between which communication is to be performed.

In Fig. 20, when re-transmission of the message is performed using the logic between the GS for communication therebetween. the shown message identifier 200 is always added. Both the transmitter side and the receiver side GS stores the message identifier 300 in the non-volatile memory 5.

The message identifier 300 comprises identifiers of a multi demand ID 300-1, a demand counter 300-2 and a re-transmission counter 300-3. The

identifier performs the following functions and the method of use is discussed as follows.

The multi demand ID 300-1 designates a communication path. Namely, based on the logic of the transmitter side GS, an ID is assigned for every demand. At the transmitter side GS, in order to process a plurality of demands simultaneously, it is necessary at the receiver side to process a plurality of demands simultaneously. Therefore, in order to assign the communication path for each demand, the multi demand ID is used. In order to control expansion of the capacity of the non-volatile memory 5, at the transmitter side GS, when the demand including a re-transmission demand is completed, namely when the response indicative of reception of the message from the receiver side GS is received, the multi demand ID 300-1 will be used for other demands.

On the other hand, at the receiver side GS, there is provided areas for storing the content of the message for each of the multi demand IDs. Namely, in order to prevent this storage area from increasing, the multi demand ID is used repeatedly.

The demand counter 300-2 represents the order of the demand in the communication path determined by the multi demand ID 300-1 in a straightforward fashion. When one demand is completed and a new demand is to be processed, the transmitter side GS transmits a message by adding "1" to the counter value.

On the other hand, at the receiver side GS, if the message having a counter value greater than the immediately preceding counter value, is received, the process performed is regarded as a new demand.

The re-transmission counter 300-3 represents the number of occurrences of re-transmission for one demand. At the transmitter side GS, "0" sets forth a new demand, and the counter value is incremented by "1" for every occasion of re-transmission.

On the other hand, at the receiver side GS, when the counter value of the received message is greater than the immediately preceding counter value, the process performed is regarded as a re-transmitted demand.

The communication path between the transmitter side GS and the receiver side GS is specified by the content of the multi demand ID 300-1, and for each communication path, the content of messages, particularly the message identifiers 300 are stored in the non-volatile memory at both the transmitter side and the receiver side.

Accordingly, even when the transmitter side GS is down, the stand-by system 200 can make the message identifier 300 stored in the non-volatile memory reference form a new message identifier and then transmit to the receiver side GS though the communication control stage 50 together with the message. At the receiver side GS, by comparing the content of the new message identifier 300 with the content of the immediately preceding old message identifier 300, discrimination for the newly re-transmitted message can be performed. This enables prevention of the loss of messages and detection of redundant transmissions.

Fig. 21 shows the diagram of the embodiment on the software of the third aspect of the invention. The reference numeraL 101 denotes GS space at the transmitter side current system. The reference numeral 101-1 denotes a program area. The reference numeral 101-2 denotes a data area. The reference numeral 101-5 denotes a transmitting message table. The reference numeral 102 denotes a GS space for the transmitter side stand-by system. The reference numeral 201 denotes a GS space for the receiver side current system. The reference numeral 201-1 denotes a program area The reference numeral 201-2 denotes a data area. The reference numeral 201-5 denotes a receiving message table. The reference numeral 202 denotes a GS space for the receiver side stand-by system. The reference numeral 50 denotes a supervisor of the message communication control stage.

For the message identifier MSG ID1 to 3, respective of three identifiers as shown in Fig. 20 are contained for each message identifier MSG ID.

In Fig. 21, the GS space 102 for the transmitter side stand-by system and the GS space 202 for the receiver side stand-by system are to be started and generated when the GS space 101 of the transmitter side current system or the GS space 201 of the receiver side current system goes down. These can be considered as not existing in the normal operation.

On the other hand, in the instant drawing, the lowest digit of the reference numerals can be considered to correspond to the reference numerals of the hardware of Fig. 19.

It should be appreciated that, though Fig. 21 does not illustrate the non-volatile memory 5 shown in Fig. 19, the non-volatile memory 5 exists as the transmitting message table 101-5 and the receiving message table 202-5.

Fig. 22 is a flowchart of the message transmitting process to be executed by the transmitter side server in the third aspect. Fig. 23 shows a flowchart of a re-transmission process when the transmitter side server is re-started. Fig. 24 shows a flowchart showing a message receiving process executed by the receiver side server.

In Fig. 22, when a message transmission demand is generated at the GS space 101 of the transmitter side current system, the message communication path is obtained for preparation of the

message transmission demand. Namely, the multi demand ID, which is not currently used, for example MSG ID1, is obtained (step 1). Then, the demand counter of the MSG ID1 is incremented by "1" (step 2). Also, the re-transmission counter value of the MGS ID1 is set to "0" (step 3). With respect to the MSG ID thus generated, the content of the message ID is stored in the transmitting message table 101-5 together with the content of the message. Also the content of the message ID and the content of message are also stored in the non-volatile memory, which is not shown (corresponding to the non-volatile memory of Fig. 19). The non-volatile memory is accessible even by the GS space of the stand-by system (step 4). Then, a request is made to the supervisor 104 with the content of the message together with the corresponding message identifier MSG ID1 for a message transmission. Then, a response message is received (step 5). When the response message represents receipt of the transmitted message, namely, when each item of the message and the message identifier are stored in the MSD Id and the message content storing area in the receiving message table 201-5 of the GS space 201. If the process is not interrupted by the receiver side GS (step 6), then an opening of the message communication path is performed (step 8).

In Fig. 23, when the transmitter side current GS is down for some reason, the transmitter side stand-by GS is started so that the GS space 102 of the transmitter side stand-by system takes over the process of the GS space 101 of the transmitter side current system, to re-transmit the message. Namely, in the GS space 102 of the transmitter side stand-by system, the content of the message communication stored in the non-volatile memory, for example, the message identifier and content of message associated with the message identifier MSG ID1 in the case that the re-retransmission process is performed for the message identifier MSG ID1, is read out from the above-mentioned non-volatile memory, and stores it in the transmission message table of the GS space 102 of the transmitter side stand-by system (step 11). Thereafter, the re-transmission counter value of the message identifier is incremented by "1" (step 12), the MSG ID1 on the transmission message table is replaced with the new message identifier and the new message identifier is stored in the non-volatile memory (step 4). Then, as in Fig. 22, a message transmission is requested to the supervisor 104 by adding the new message identifier MSG ID1 to the corresponding message content. The response message thereto is received by the GS of the stand-by system (step 5). Since the subsequent process is identical to that of Fig. 22, the discussion is neglected.

Since the message identifier and the content of message to be transmitted immediately before the transmitter side current system goes down are maintained in the non-volatile memory, even when the GS space 101 of the transmitter side current system because impossible to use, the GS space 102 of the transmitter side stand-by system, which is initiated in place, can restore the state immediately before the transmitter side current system goes down.

On the other hand, upon re-transmission of the message, since the state immediately before the occurrence of the transmitter side current system can be restored, re-transmission can be easily performed based thereon.

In Fig. 24, the content of the message and the message identifier thereof transmitted from the GS of the transmitter side current system or the stand-by system, are received by the GS space 201 of the receiver side current system or the GS space 202 of the receiver side stand-by system in case the GS of the receiver side current system is down. The GS space 201 of the receiver side current system stores the content of the message and the message identifier thereof in the receiving message table 201-5.

Once the storing in the receiving message table 201-5 is successfully completed, the GS of the receiver side current system requests transmission of the receiving message for notifying reception to the supervisor 104. On the other hand, when the receiver side current system is down and cannot receive the message transmitted from the GS of the transmitter side, the supervisor 104 transmits a response notifying this fact to the GS of the transmitter side current system,. Then the receiver side stand-by system is initiated. Thereafter through the process set forth above, the re-transmitted transmitting message is stored in the receiving message table in the GS space 202 of the receiver side stand-by system. Then, the GS of the receiver side stand-by system requests the supervisor 104 to transmit the response message notifying reception.

Under such conditions, namely, the message is received by the GS of the receiver side, discussion will be provided for the example in which the message is received by the current system. The content of the receiving message received by the receiver side current system is extracted (step 21). Then, judgement of same or different is done the message identifier 300 given for the received message and shown in Fig. 20. As search is performed against the receiving message table 201-5 for finding the message identifier having the same multi demand ID 300-1 (step 22). Then entry consistent with the multi demand ID exists in the receiving message table 200-5 (step 23), for example when the MSG ID1 is consistent with the multi demand

ID, subsequently comparison for the demand counter 300-2 of the message identifier 300 with the counter value of the demand counter of the MSG ID1 (step 24). If the re-transmission counter of the received message is not greater, comparison for the re-transmission counter 300-3 of the message identifier with the counter value of the re-transmission counter of the MSG ID1 is made (step 25). When the re-transmission counter of the received message is greater, the content of the received message, namely, the content of the message and the message identifier are written in the area for MSG ID1 of the receiver side non-volatile memory, which is not shown. Accordingly, the preceding memory content is erased (step 26). At the same time, the GS of the receiver side current system updates the content of the receiving message of the area for MSG ID1 in the receiving message table 201-5. Namely, the process is performed regarding the message transmitted in response to a demand for re-transmission due to occurrence of system down of the GS at the transmitter side or the GS at the receiver side (in case GS is current system) (step 27).

When the re-transmission counter of the received message is not greater than the re-transmission counter of MSG ID1 at step 25, as set out with respect to the re-transmission counter of the message identifier 300, according to the rule for performing re-transmission with incrementing "1" at every occasion, the process performed regarding the received message is the redundant transmission of the already received message (step 30).

On the other hand, when the demand counter of the received message is greater than the demand counter of MSG ID1 at step 24, as discussed with respect to the demand counter in the message identifier 5, according to the rule for adding "1" when a new demand is processed after completion of one demand, to transmit, the content of the message, namely the content of message and the message identifier, are stored in the not shown non-volatile memory regarding the received new message (step 28). At the same time, the GS of the receiver side current system updates the content of the receiving message on the receiving message table 201-5 and perform a process as the new demand (step 29).

Similarly, when the multi demand ID of the received message is not entered in the receiving message table 201-5 at step 23, the content of the message and the message identifiers are written in the area for new MSG ID1 of the not shown non-volatile memory of the receiver side regarding a completely new message.

In the above, discussion has been made for Fig. 24 with respect to the case that the receiver side is the current system GS. However, even when the current system GS is down and thus the stand-by system GS is started, the GS of the stand-by system, once started, can perform the process for re-establishment of the receiving message table in the GS of the stand-by system at that time in the aid of the receiver side non-volatile memory, which is not shown. Therefore, the process similar to that discussed with respect to the GS of the current system can be performed.

As set forth above, according to the third aspect of the invention, even when the GS at the receiver side is down, reference can be made to the old message identifier stored in the non-volatile memory to generate a new message identifier corresponding to the transmission format. Then, the message identifier is transmitted together with the content of the message. Furthermore, since the architecture is taken to perform a comparison of the new message identifier and the stored old message identifier at the GS of the receiver side, the message can be recognized as the re-transmitted message at the GS of the receiver side. Therefore, prevention of loss of the message and detection of the retention transmission can be achieved. Accordingly, system down can be successfully avoided.

FIELD OF UTILIZATION IN INDUSTRY

The present invention is effective for the approach to fault toleration in the distributed processing system established by coupling nodes with the network, and particularly effective against crushing due to failure in the software.

LIST OF REFERENCE NUMERALS

1	NODE
2	NETWORK
3	PROCESSOR
4	VOLATILE MEMORY
5	NON-VOLATILE MEMORY
6	COMMUNICATION DEVICE
10	CLIENT SERVER
12	MESSAGE TRANSMISSION STAGE
13	RE-TRANSMISSION COUNT MANAGING STAGE
14	NOTICE CONTENT DISCRIMINATING STAGE
15	VOLATILE MEMORY
16	NON-VOLATILE MEMORY
20	RECEPTION SERVER
20a	FIRST SERVER
20x	FILE NAME MANAGING SERVER
21	MESSAGE RECEIVING STAGE
22	PROCESSING SERVER IDENTIFYING STAGE
23	MESSAGE TRANSMITTING STAGE

24	RE-TRANSMISSION COUNT MANAGING STAGE
25	DEMAND DISCRIMINATION STAGE
30	PROCESSING SERVER
30b	SECOND SERVER
30x	FILE RESOURCE MANAGING SERVER
31	MESSAGE RECEIVING STAGE
32	CHANGE OVER INFORMATION MANAGING STAGE
34	SERVICE PROVIDING STAGE
35	DEMAND PROCESSING STAGE
36	VOLATILE MEMORY
37	JUDGEMENT STAGE
38	WRITING STAGE
39	NON-VOLATILE MEMORY
40	RECOVERY STAGE
41	ISSUING STAGE
50	MESSAGE COMMUNICATION CONTROL STAGE
60	MESSAGE COMMUNICATION AUTHORITY MANAGING STAGE
100	CURRENT SYSTEM
100-1	PROCESSOR
100-10	CLIENT MESSAGE COMMUNICATION PROCESSING STAGE
100-11	IDENTIFIER DISCRIMINATION PROCESSING STAGE
200	STAND-BY SYSTEM
200-1	PROCESSOR
200-2	MAIN MEMORY
200-11	IDENTIFIER DISCRIMINATION PROCESSING STAGE
300-1	MULTI DEMAND ID
300-2	DEMAND COUNTER
300-3	RE-TRANSMISSION COUNTER
301	SERVER MESSAGE COMMUNICATION PROCESSING STAGE
302	SERVER DEMAND PROCESSING STAGE

Claims

1. A message communication processing system in a distributed processing system, comprising a client server, a processing server and a reception server including a demand discrimination means, said demand discrimination means distinguishing a demand only for processing references and not associated with updating the medium or exclusiveness of resources, and a demand for a reference process and a reference and updating process associated with the change of state of the resource.

2. A message communication processing system as set forth in claim 1, wherein said processing server comprises a discrimination stage for discriminating whether the process for the message transmitted from the client has already been completed or not, a demand processing stage for performing a process for the message from the client when said discriminating stage determines that the process is not completed, a writing stage for writing the results of process performed in said demand processing stage to a non-volatile memory, and an issuing stage for issuing a notice that the process has already been performed in said discrimination stage and a notice that the process at the demand processing stage is normally completed when it is determined that the process is not completed, said client makes a judgement as normal when said notice that the process has already been performed, when a re-transmission process for the message is performed.

3. A message communication processing system as set forth in claim 1, wherein said reception server identifies a processing server which becomes a service provider for the service demand, and demands provision of the service for the identified processing server, said reception server adds an identifier and a re-transmission count added to the message from the client to the message to be transmitted to the process server, and said process server holds the identifier and two kinds of re-transmission counts as change over information for a stand-by system, said processing server performing a comparison for said two kinds of re-transmission counts with the held values corresponding to said re-transmission count to determine whether said message is a re-transmitted message or redundantly transmitted message.

4. A message communication processing system as set forth in claim 3, wherein, the process in the comparison is performed in such a manner that, when said re-transmission count is greater than the corresponding held value, judgement as to the re-transmitted message is made, when smaller, the judgement as to the redundantly transmitted message is made, and when equal, a further comparison is made for the re-transmission count added to said message by said reception server with the corresponding held value to make a judgement as the re-transmitted messages when greater and make a judgement as to redundantly transmitted messages when smaller or equal.

5. A message communication processing system as set forth in claim 3, wherein, for the system

including a stand-by system in addition to a current system, a non-volatile memory for storing the message and the message identifier, is provided in common with said current system and said stand-by system, and for the current system and the stand-by system, an identifier discrimination stage for discriminating whether the message identifier is the same or different, proceeds; said message identifier comprises a multi demand ID, content of a demand counter and content of a re-transmission counter, said multi demand ID and message identifier corresponding to the contend of new and re-transmissions, are added when the message is transmitted.

Fig. 1

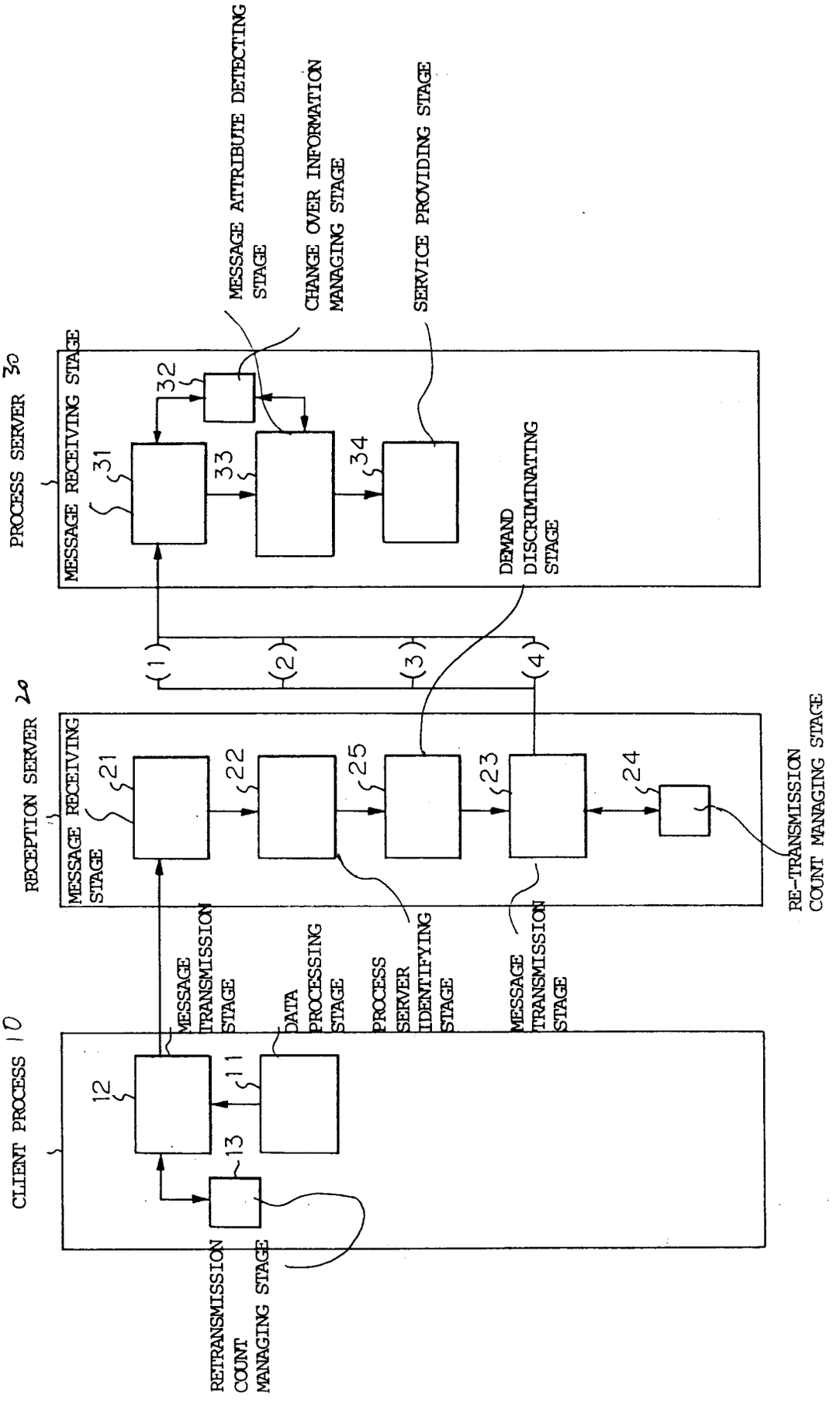

CLIENT PROCESS 10
RECEPTION SERVER 20
PROCESS SERVER 30
MESSAGE RECEIVING STAGE
MESSAGE RECEIVING STAGE
MESSAGE ATTRIBUTE DETECTING STAGE
CHANGE OVER INFORMATION MANAGING STAGE
SERVICE PROVIDING STAGE
DEMAND DISCRIMINATING STAGE
MESSAGE TRANSMISSION STAGE
DATA PROCESSING STAGE
PROCESS SERVER IDENTIFYING STAGE
MESSAGE TRANSMISSION STAGE
RE-TRANSMISSION COUNT MANAGING STAGE
RETRANSMISSION COUNT MANAGING STAGE
11
12
13
21
22
23
24
25
31
32
33
34
(1)
(2)
(3)
(4)

Fig. 2

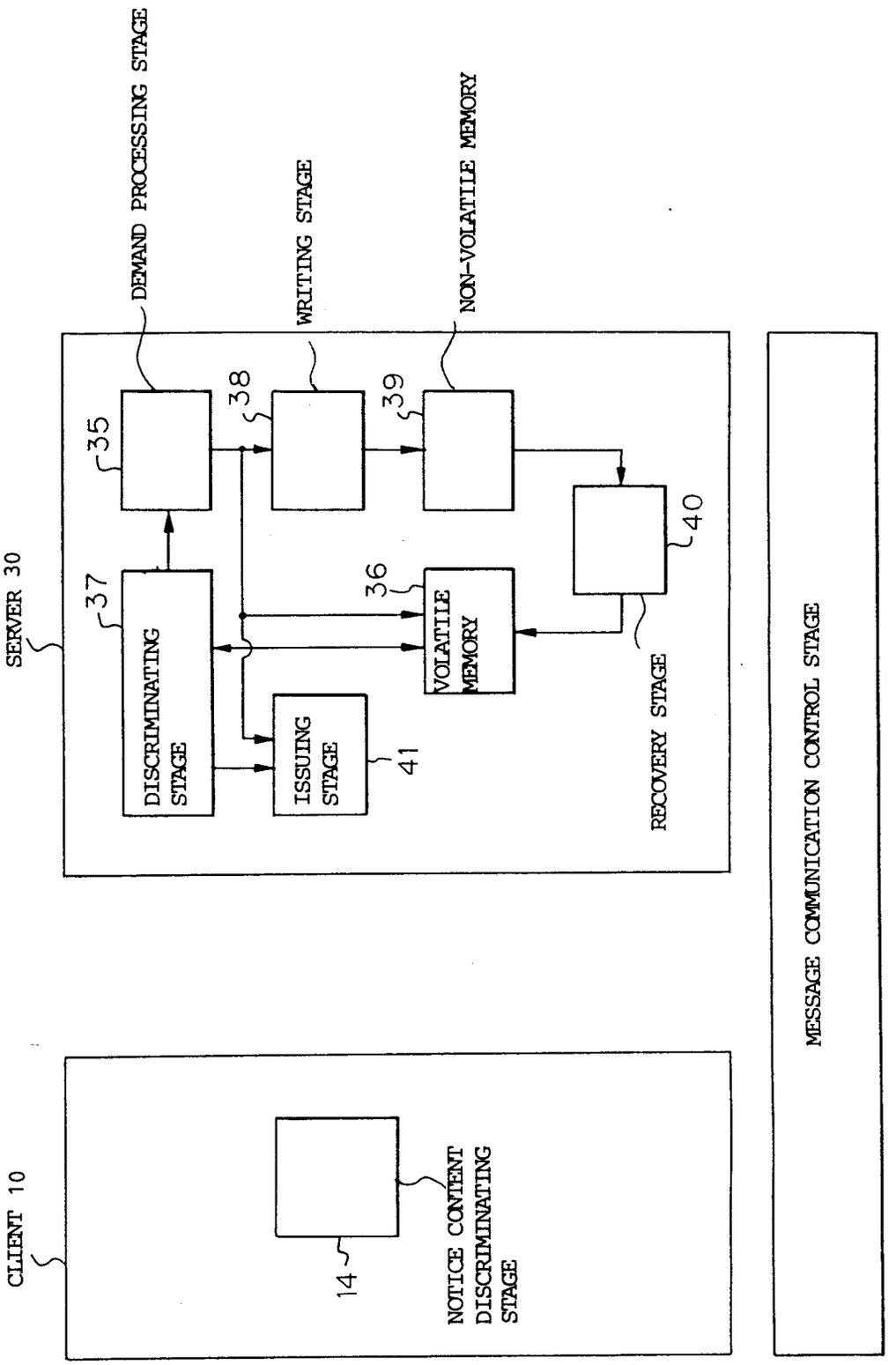

CLIENT 10
14
NOTICE CONTENT DISCRIMINATING STAGE
SERVER 30
DEMAND PROCESSING STAGE
WRITING STAGE
NON-VOLATILE MEMORY
35
38
39
40
37
36
DISCRIMINATING STAGE
ISSUING STAGE
41
VOLATILE MEMORY
RECOVERY STAGE
MESSAGE COMMUNICATION CONTROL STAGE

Fig. 3

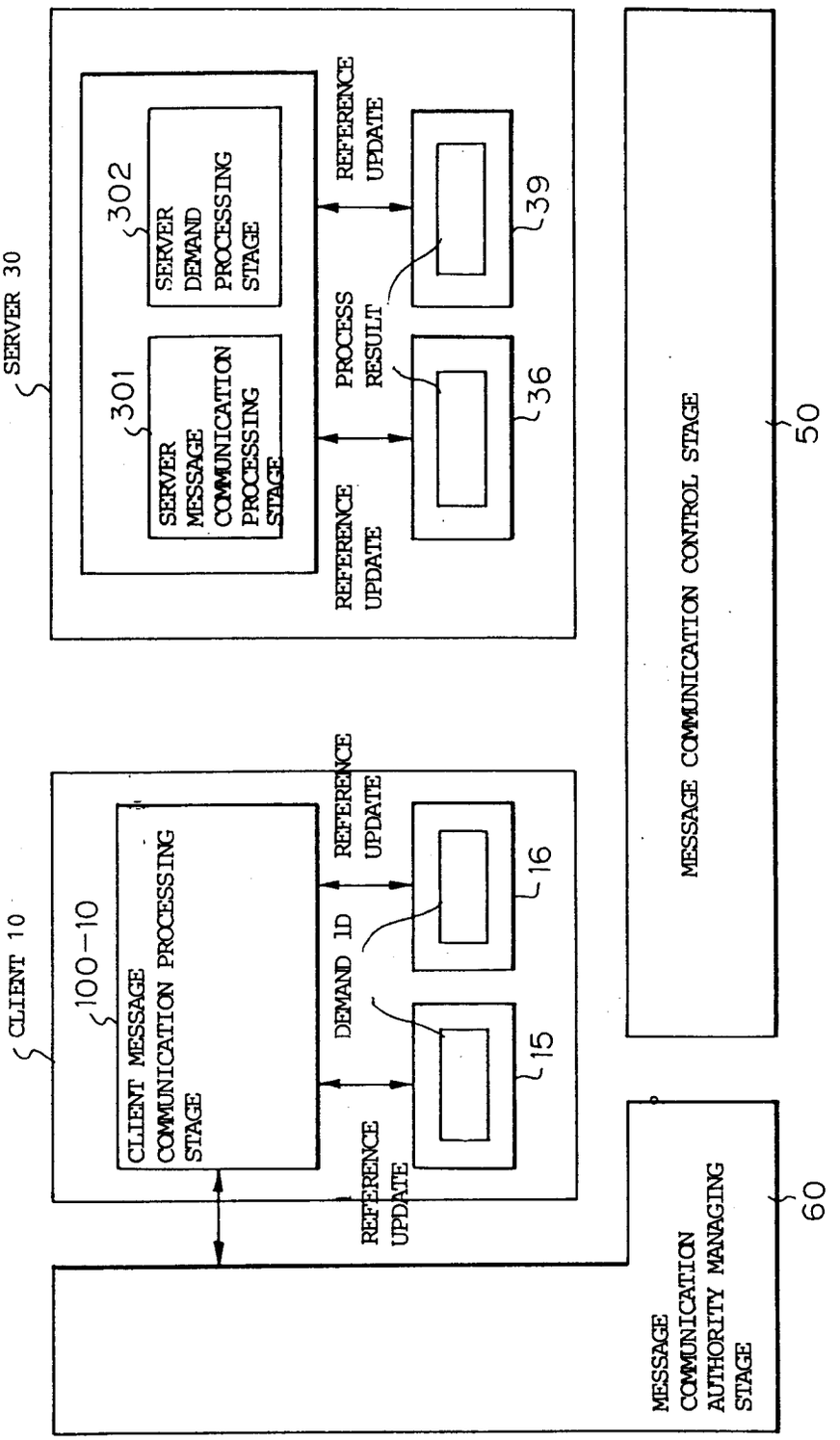

SERVER 30
301
SERVER MESSAGE COMMUNICATION PROCESSING STAGE
302
SERVER DEMAND PROCESSING STAGE
REFERENCE UPDATE
PROCESS RESULT
REFERENCE UPDATE
36
39
CLIENT 10
100-10
CLIENT MESSAGE COMMUNICATION PROCESSING STAGE
DEMAND ID
REFERENCE UPDATE
15
16
REFERENCE UPDATE
MESSAGE COMMUNICATION CONTROL STAGE
50
MESSAGE COMMUNICATION AUTHORITY MANAGING STAGE
60

Fig. 4

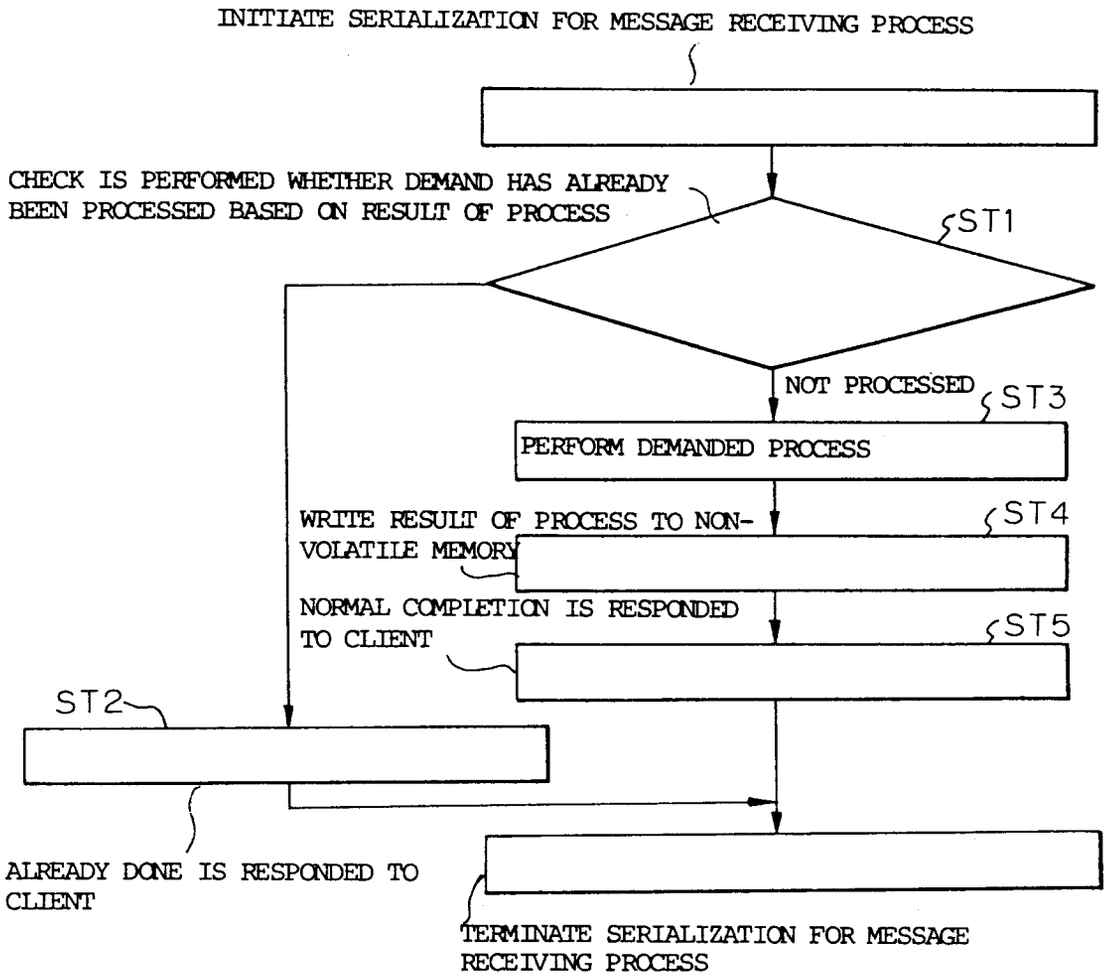

INITIATE SERIALIZATION FOR MESSAGE RECEIVING PROCESS
CHECK IS PERFORMED WHETHER DEMAND HAS ALREADY BEEN PROCESSED BASED ON RESULT OF PROCESS
ST1
NOT PROCESSED
ST3
PERFORM DEMANDED PROCESS
WRITE RESULT OF PROCESS TO NON-VOLATILE MEMORY
ST4
NORMAL COMPLETION IS RESPONDED TO CLIENT
ST5
ST2
ALREADY DONE IS RESPONDED TO CLIENT
TERMINATE SERIALIZATION FOR MESSAGE RECEIVING PROCESS

Fig. 5

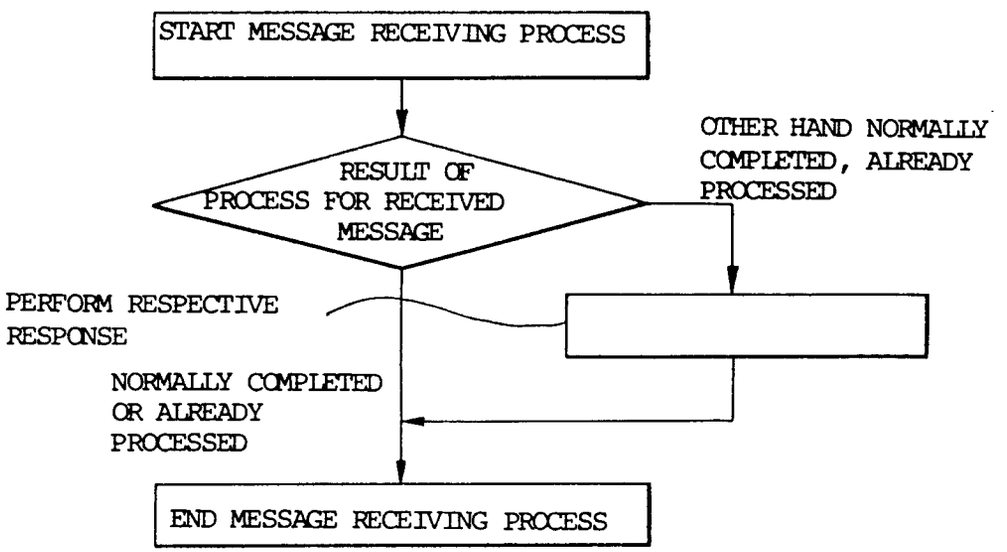

START MESSAGE RECEIVING PROCESS
RESULT OF PROCESS FOR RECEIVED MESSAGE
OTHER HAND NORMALLY COMPLETED, ALREADY PROCESSED
PERFORM RESPECTIVE RESPONSE
NORMALLY COMPLETED OR ALREADY PROCESSED
END MESSAGE RECEIVING PROCESS

Fig. 6

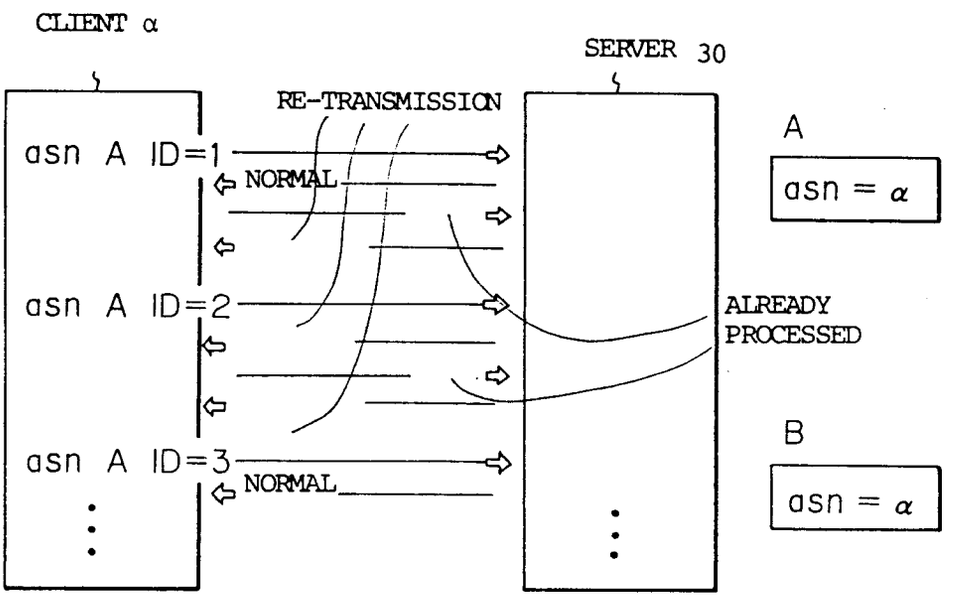

CLIENT α
SERVER 30
RE-TRANSMISSION
asn A ID=1
NORMAL
asn A ID=2
asn A ID=3
NORMAL
ALREADY PROCESSED
A
asn = α
B
asn = α

Fig. 7A

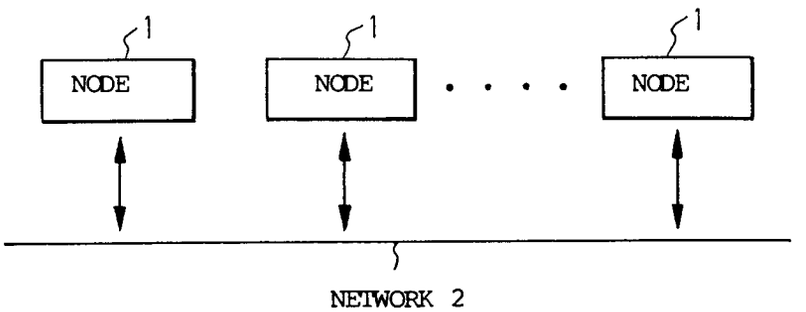

1
NODE
1
NODE
1
NODE
NETWORK 2

Fig. 7B

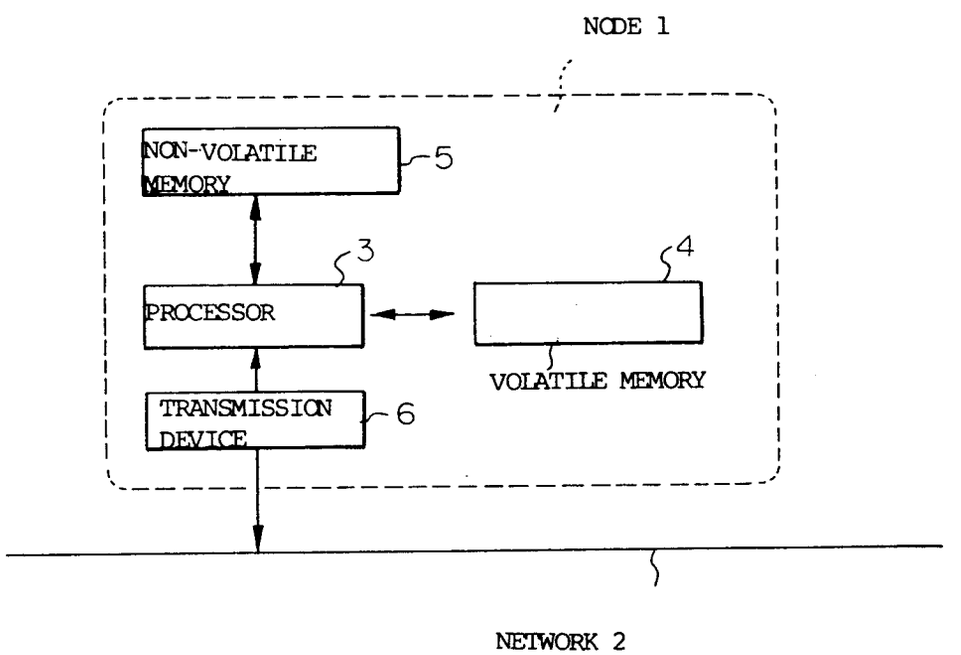

NODE 1
NON-VOLATILE MEMORY
5
3
PROCESSOR
4
VOLATILE MEMORY
TRANSMISSION DEVICE
6
NETWORK 2

Fig. 8A

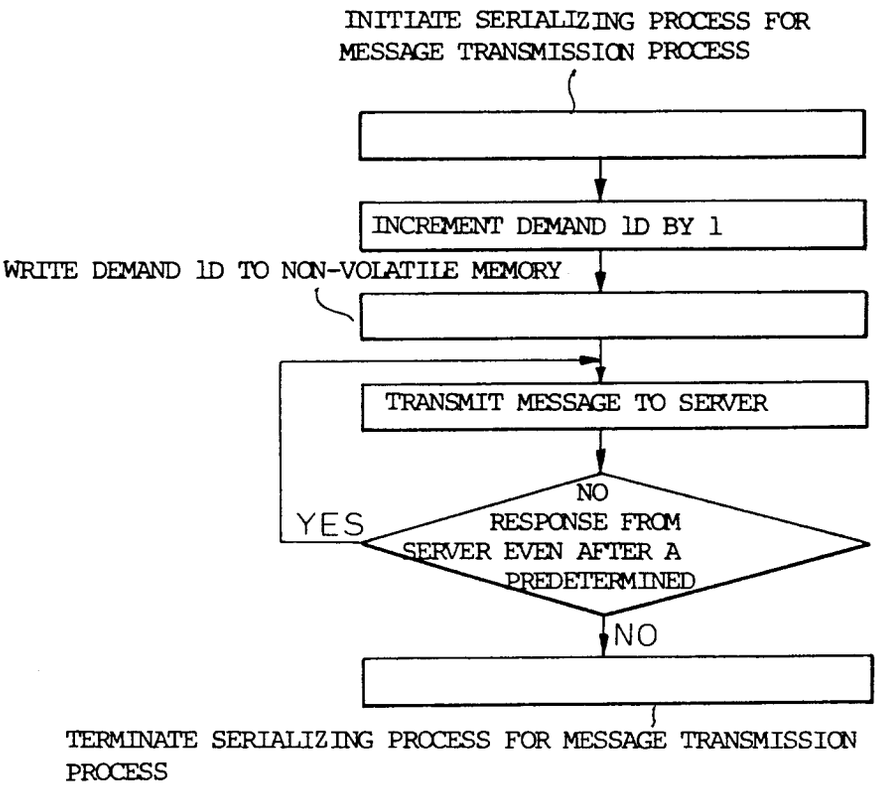

INITIATE SERIALIZING PROCESS FOR MESSAGE TRANSMISSION PROCESS
INCREMENT DEMAND ID BY 1
WRITE DEMAND ID TO NON-VOLATILE MEMORY
TRANSMIT MESSAGE TO SERVER
YES
NO RESPONSE FROM SERVER EVEN AFTER A PREDETERMINED
NO
TERMINATE SERIALIZING PROCESS FOR MESSAGE TRANSMISSION PROCESS

Fig. 8B

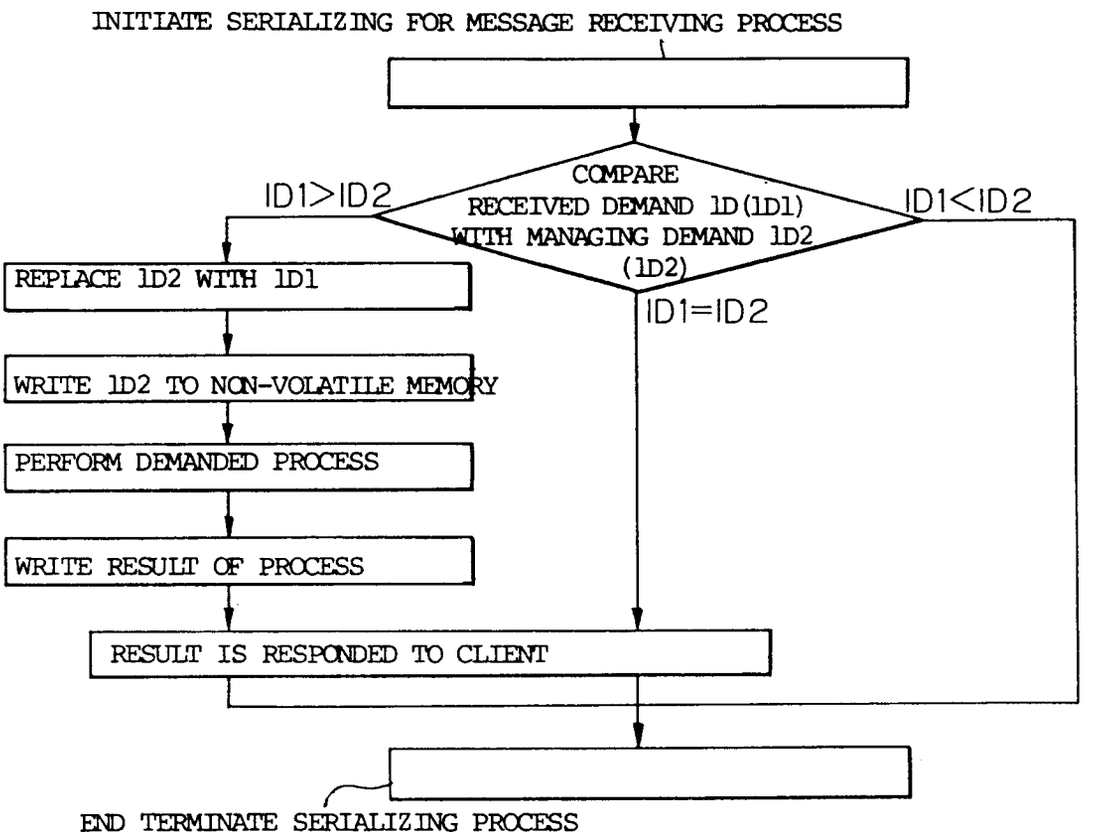

INITIATE SERIALIZING FOR MESSAGE RECEIVING PROCESS
COMPARE RECEIVED DEMAND ID(ID1) WITH MANAGING DEMAND ID2 (ID2)
ID1>ID2
ID1<ID2
ID1=ID2
REPLACE ID2 WITH ID1
WRITE ID2 TO NON-VOLATILE MEMORY
PERFORM DEMANDED PROCESS
WRITE RESULT OF PROCESS
RESULT IS RESPONDED TO CLIENT
END TERMINATE SERIALIZING PROCESS

Fig. 9A

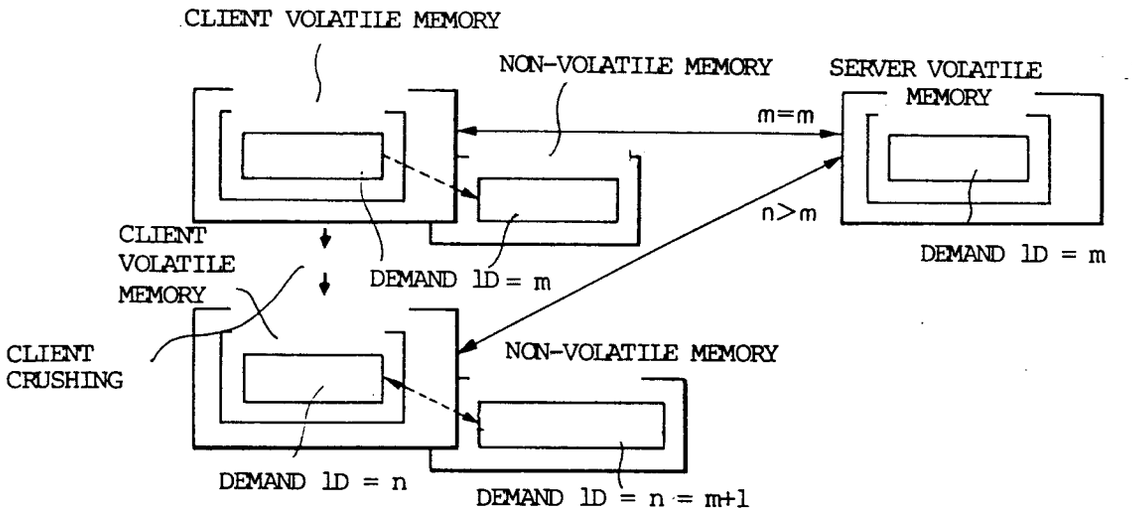

CLIENT VOLATILE MEMORY
NON-VOLATILE MEMORY
SERVER VOLATILE MEMORY
m=m
n>m
CLIENT VOLATILE MEMORY
DEMAND ID = m
DEMAND ID = m
CLIENT CRUSHING
NON-VOLATILE MEMORY
DEMAND ID = n
DEMAND ID = n = m+1

Fig. 9B

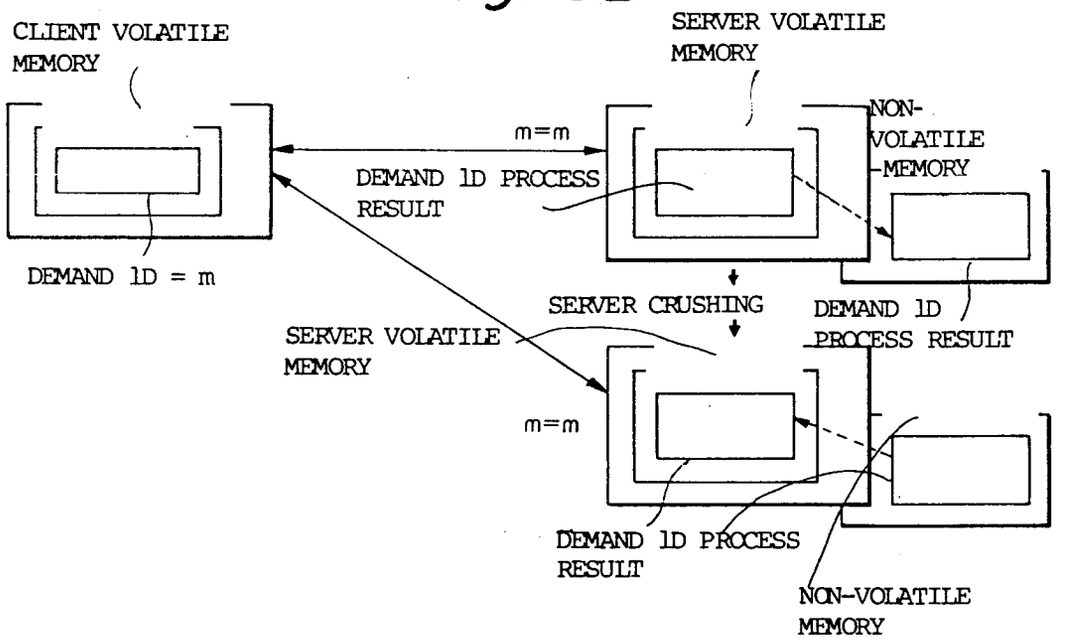

CLIENT VOLATILE MEMORY
SERVER VOLATILE MEMORY
m=m
NON-VOLATILE MEMORY
DEMAND ID PROCESS RESULT
DEMAND ID = m
SERVER CRUSHING
DEMAND ID PROCESS RESULT
SERVER VOLATILE MEMORY
m=m
DEMAND ID PROCESS RESULT
NON-VOLATILE MEMORY

Fig. 10

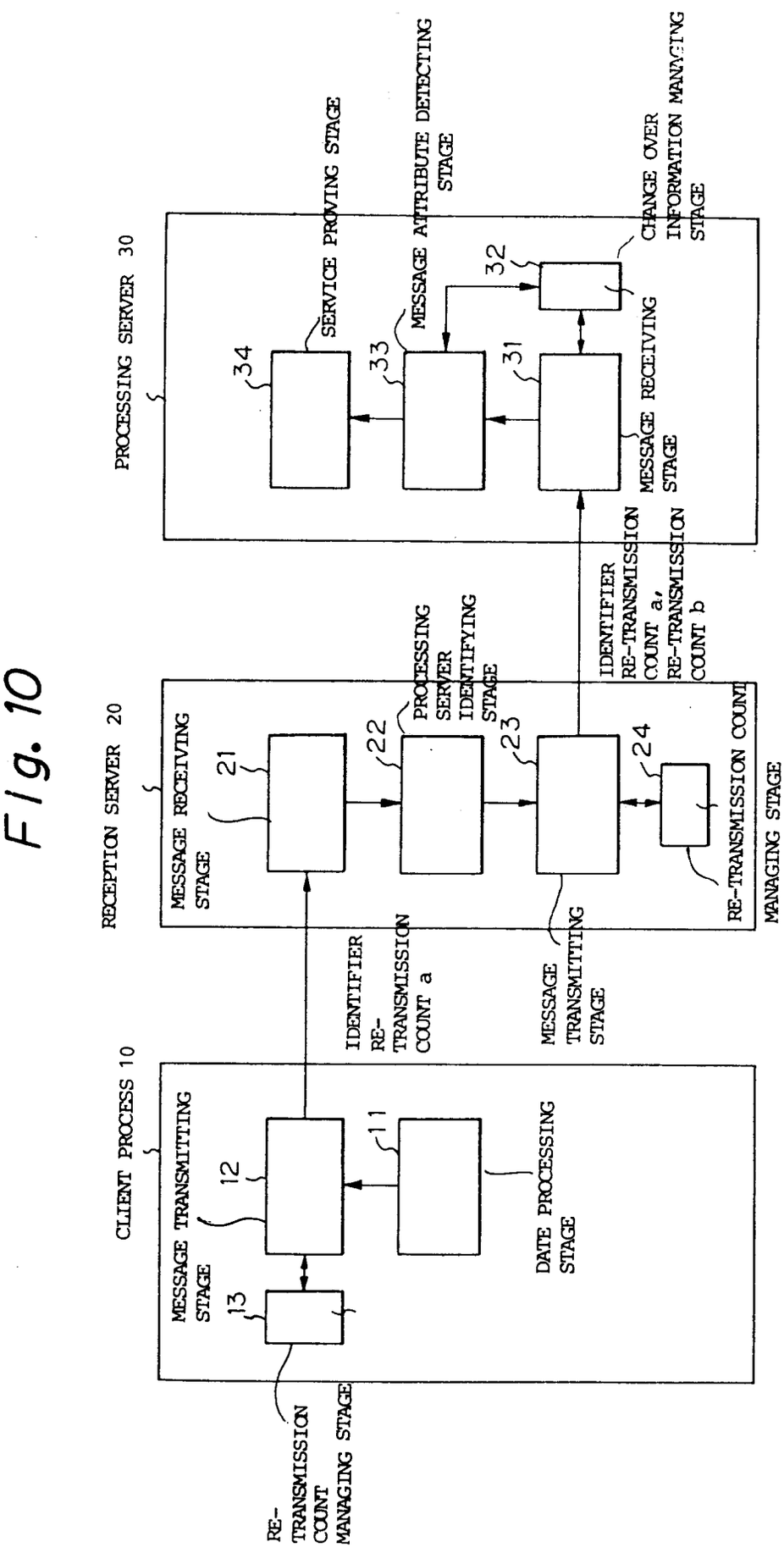

CLIENT PROCESS 10
MESSAGE TRANSMITTING STAGE
12
13
11
DATE PROCESSING STAGE
RE-TRANSMISSION COUNT MANAGING STAGE
IDENTIFIER RE-TRANSMISSION COUNT a
MESSAGE TRANSMITTING STAGE
RECEPTION SERVER 20
MESSAGE RECEIVING STAGE
21
22
PROCESSING SERVER IDENTIFYING STAGE
23
24
RE-TRANSMISSION COUNT MANAGING STAGE
IDENTIFIER RE-TRANSMISSION COUNT a, RE-TRANSMISSION COUNT b
PROCESSING SERVER 30
MESSAGE RECEIVING STAGE
31
32
CHANGE OVER INFORMATION MANAGING STAGE
MESSAGE ATTRIBUTE DETECTING STAGE
33
SERVICE PROVING STAGE
34

Fig. 11

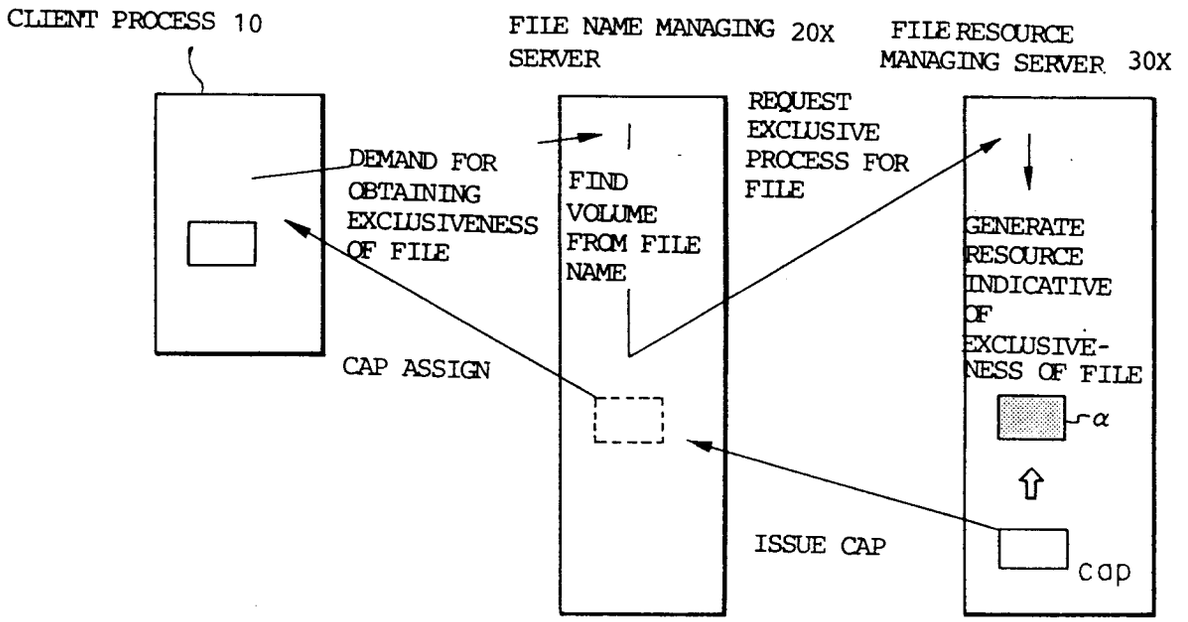

CLIENT PROCESS 10
FILE NAME MANAGING SERVER 20X
FILE RESOURCE MANAGING SERVER 30X
DEMAND FOR OBTAINING EXCLUSIVENESS OF FILE
FIND VOLUME FROM FILE NAME
REQUEST EXCLUSIVE PROCESS FOR FILE
GENERATE RESOURCE INDICATIVE OF EXCLUSIVE-NESS OF FILE
α
CAP ASSIGN
ISSUE CAP
cap

Fig. 12

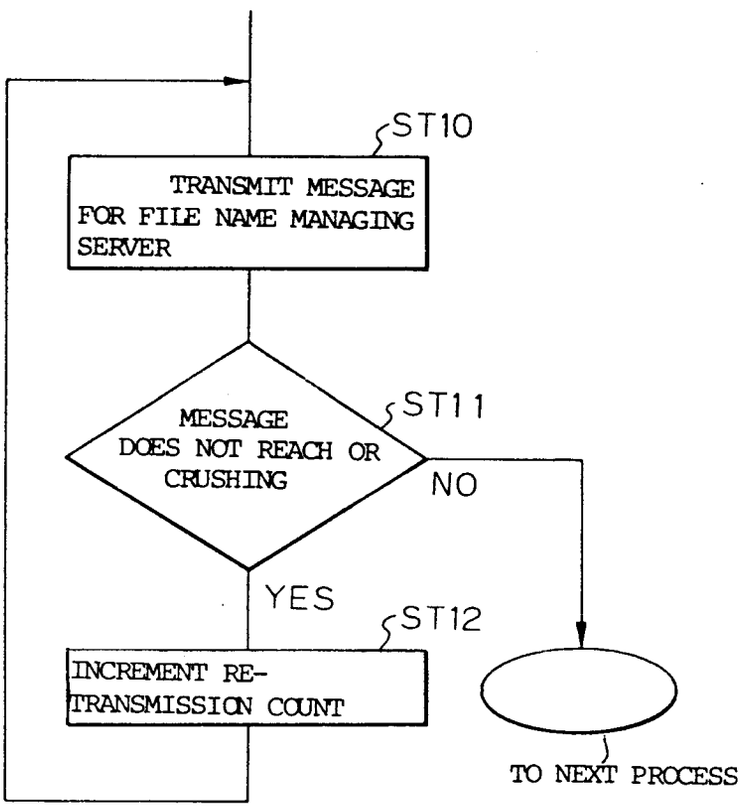

ST10
TRANSMIT MESSAGE FOR FILE NAME MANAGING SERVER
ST11
MESSAGE DOES NOT REACH OR CRUSHING
NO
YES
ST12
INCREMENT RE-TRANSMISSION COUNT
TO NEXT PROCESS

Fig. 13

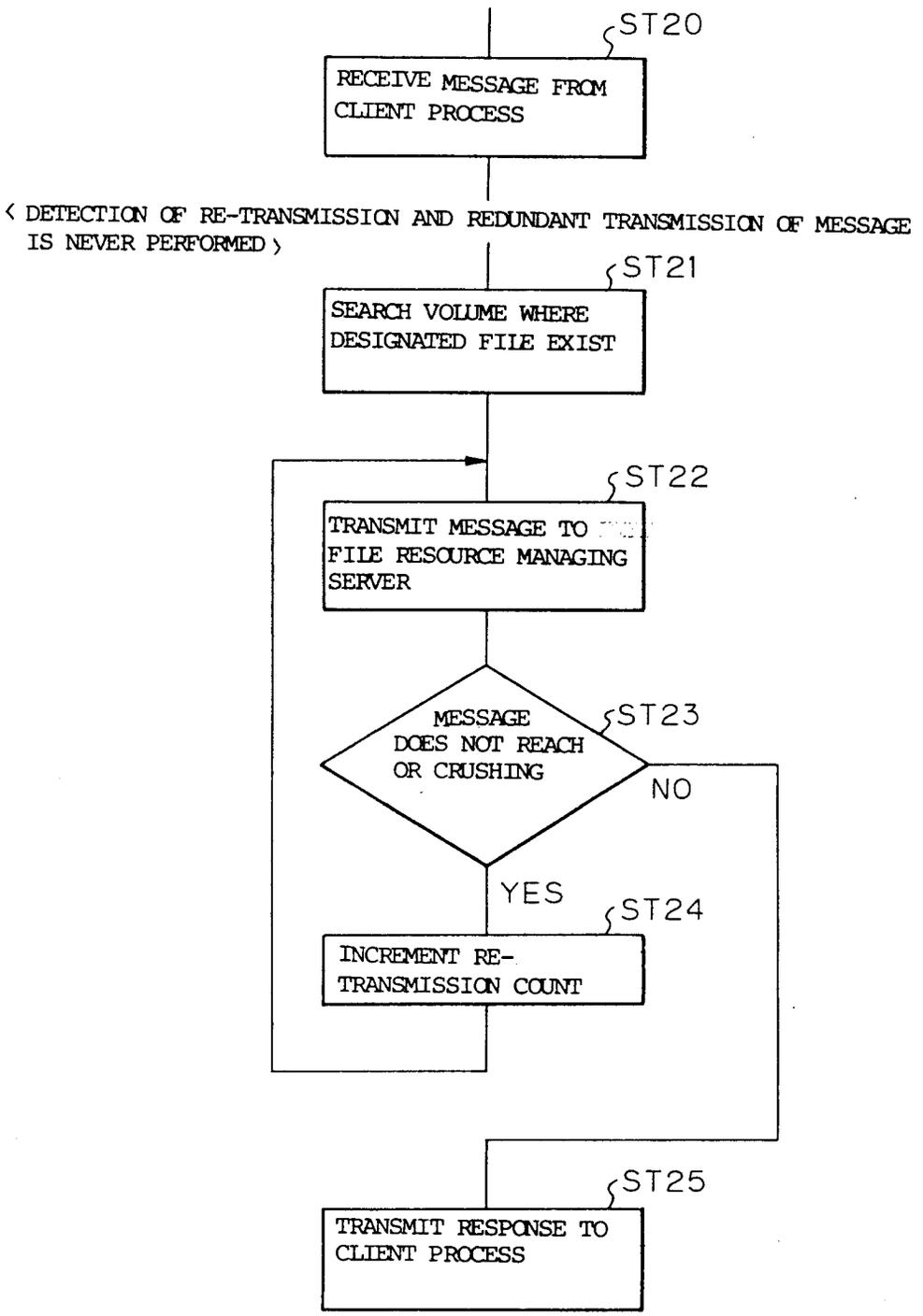

ST20
RECEIVE MESSAGE FROM CLIENT PROCESS
〈 DETECTION OF RE-TRANSMISSION AND REDUNDANT TRANSMISSION OF MESSAGE IS NEVER PERFORMED 〉
ST21
SEARCH VOLUME WHERE DESIGNATED FILE EXIST
ST22
TRANSMIT MESSAGE TO FILE RESOURCE MANAGING SERVER
ST23
MESSAGE DOES NOT REACH OR CRUSHING
NO
YES
ST24
INCREMENT RE-TRANSMISSION COUNT
ST25
TRANSMIT RESPONSE TO CLIENT PROCESS

Fig. 14

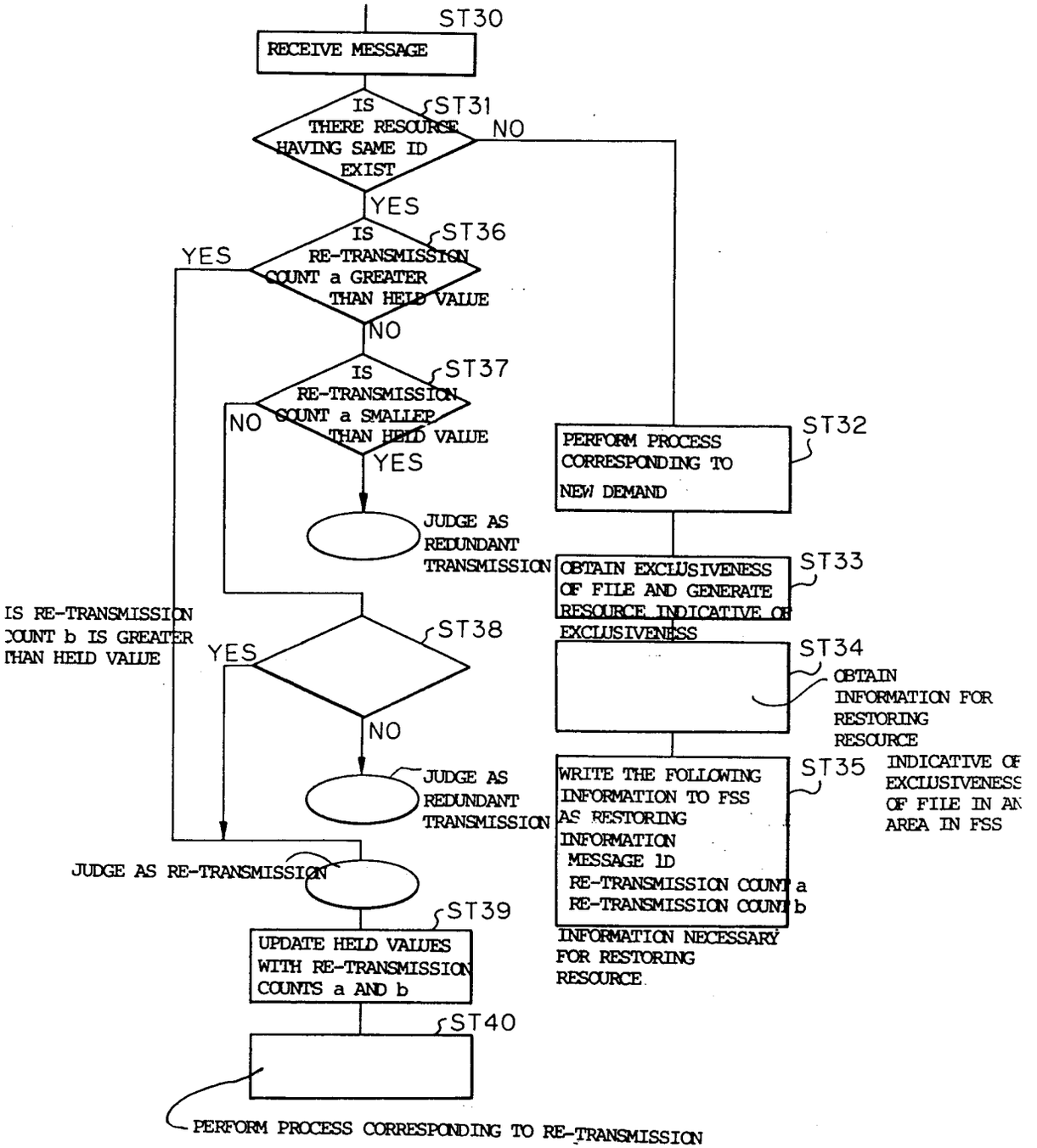

ST30
RECEIVE MESSAGE
IS THERE RESOURCE HAVING SAME ID EXIST
ST31
NO
YES
IS RE-TRANSMISSION COUNT a GREATER THAN HELD VALUE
ST36
YES
NO
IS RE-TRANSMISSION COUNT a SMALLER THAN HELD VALUE
ST37
NO
YES
JUDGE AS REDUNDANT TRANSMISSION
PERFORM PROCESS CORRESPONDING TO NEW DEMAND
ST32
OBTAIN EXCLUSIVENESS OF FILE AND GENERATE RESOURCE INDICATIVE OF EXCLUSIVENESS
ST33
ST34
OBTAIN INFORMATION FOR RESTORING RESOURCE
WRITE THE FOLLOWING INFORMATION TO FSS AS RESTORING INFORMATION
MESSAGE ID
RE-TRANSMISSION COUNT a
RE-TRANSMISSION COUNT b
ST35
INDICATIVE OF EXCLUSIVENESS OF FILE IN AN AREA IN FSS
INFORMATION NECESSARY FOR RESTORING RESOURCE
IS RE-TRANSMISSION COUNT b IS GREATER THAN HELD VALUE
ST38
YES
NO
JUDGE AS REDUNDANT TRANSMISSION
JUDGE AS RE-TRANSMISSION
ST39
UPDATE HELD VALUES WITH RE-TRANSMISSION COUNTS a AND b
ST40
PERFORM PROCESS CORRESPONDING TO RE-TRANSMISSION

Fig. 15

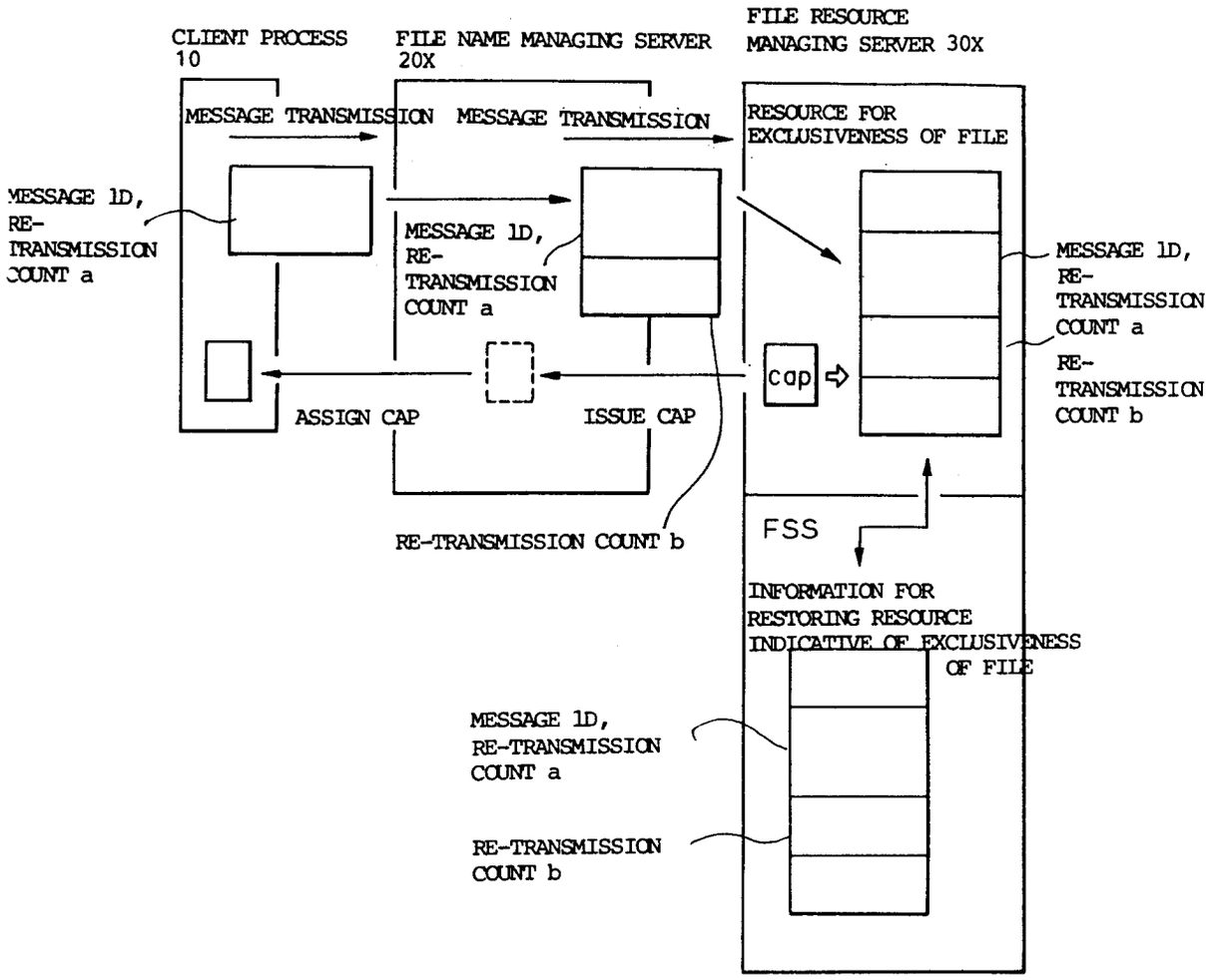

CLIENT PROCESS
10
FILE NAME MANAGING SERVER
20X
FILE RESOURCE
MANAGING SERVER 30X
MESSAGE TRANSMISSION
MESSAGE TRANSMISSION
RESOURCE FOR
EXCLUSIVENESS OF FILE
MESSAGE ID,
RE-
TRANSMISSION
COUNT a
MESSAGE ID,
RE-
TRANSMISSION
COUNT a
MESSAGE ID,
RE-
TRANSMISSION
COUNT a
RE-
TRANSMISSION
COUNT b
cap
ASSIGN CAP
ISSUE CAP
RE-TRANSMISSION COUNT b
FSS
INFORMATION FOR
RESTORING RESOURCE
INDICATIVE OF EXCLUSIVENESS
OF FILE
MESSAGE ID,
RE-TRANSMISSION
COUNT a
RE-TRANSMISSION
COUNT b

Fig. 16

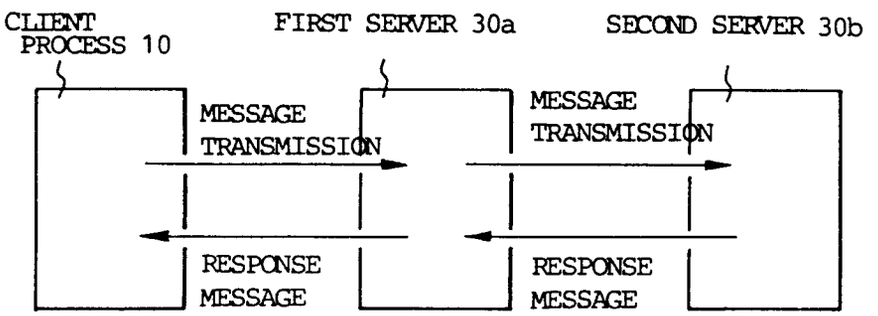

CLIENT PROCESS 10
FIRST SERVER 30a
SECOND SERVER 30b
MESSAGE TRANSMISSION
MESSAGE TRANSMISSION
RESPONSE MESSAGE
RESPONSE MESSAGE

Fig. 17

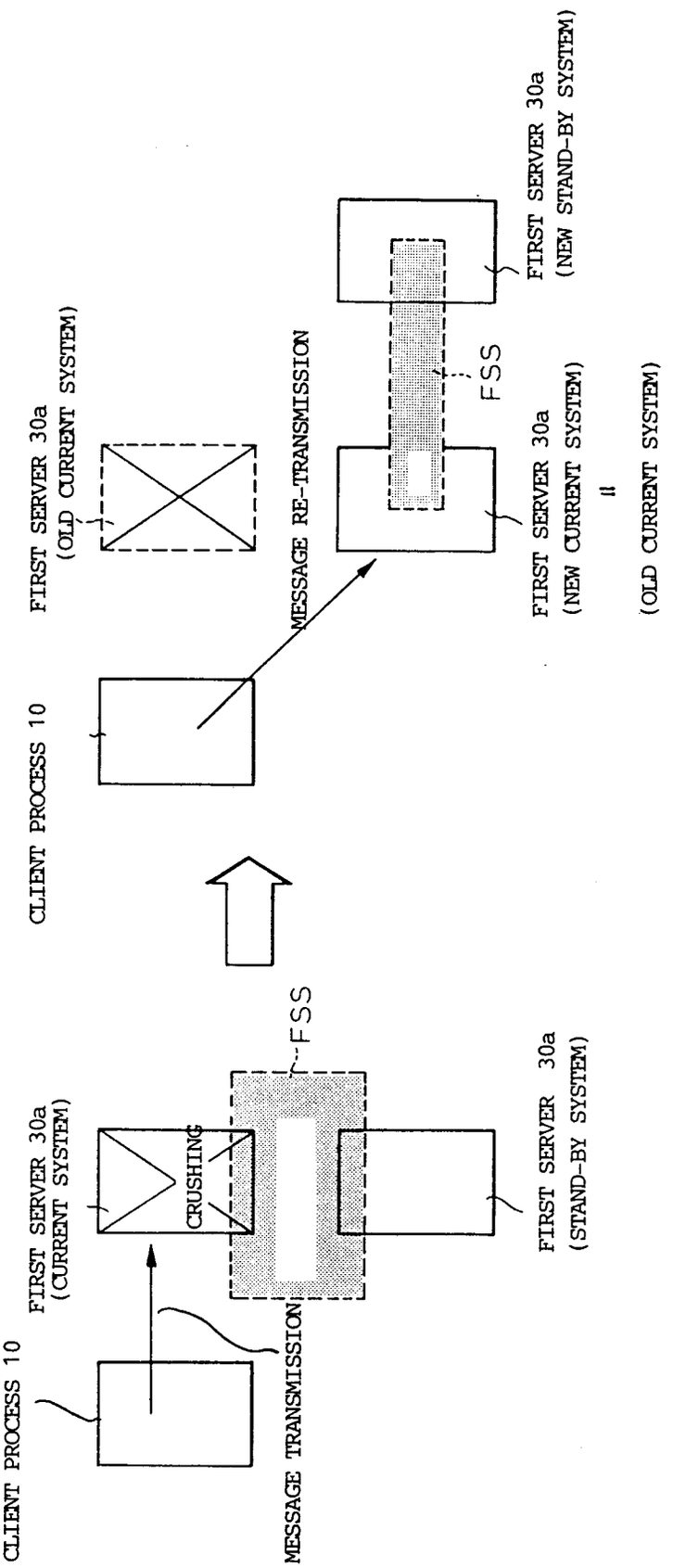

CLIENT PROCESS 10
FIRST SERVER 30a
(CURRENT SYSTEM)
CRUSHING
MESSAGE TRANSMISSION
FSS
FIRST SERVER 30a
(STAND-BY SYSTEM)
CLIENT PROCESS 10
FIRST SERVER 30a
(OLD CURRENT SYSTEM)
MESSAGE RE-TRANSMISSION
FSS
FIRST SERVER 30a
(NEW CURRENT SYSTEM)
=
(OLD CURRENT SYSTEM)
FIRST SERVER 30a
(NEW STAND-BY SYSTEM)

Fig. 18

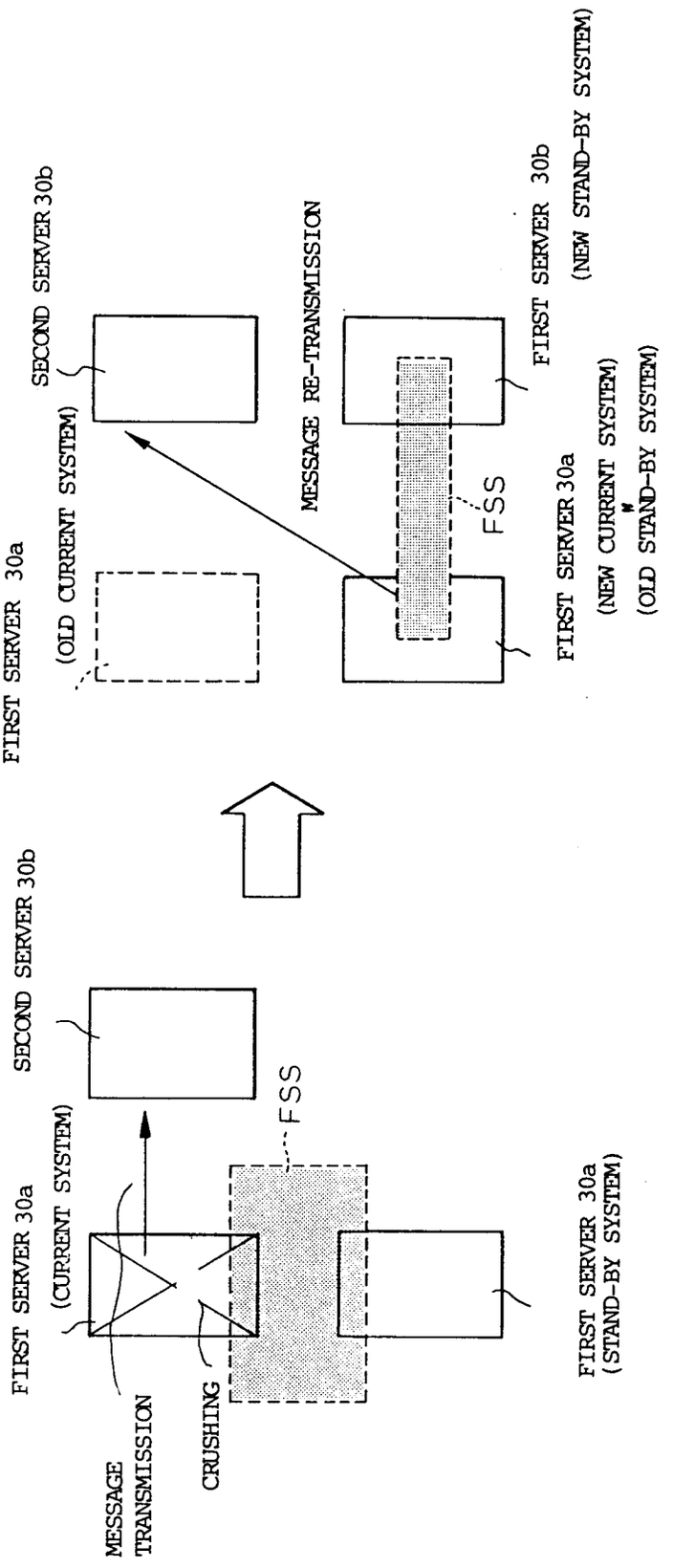

FIRST SERVER 30a
(CURRENT SYSTEM)
SECOND SERVER 30b
MESSAGE TRANSMISSION
CRUSHING
FSS
FIRST SERVER 30a
(STAND-BY SYSTEM)
FIRST SERVER 30a
(OLD CURRENT SYSTEM)
SECOND SERVER 30b
MESSAGE RE-TRANSMISSION
FSS
FIRST SERVER 30a
(NEW CURRENT SYSTEM)
FIRST SERVER 30b
(NEW STAND-BY SYSTEM)
(OLD STAND-BY SYSTEM)

Fig. 19

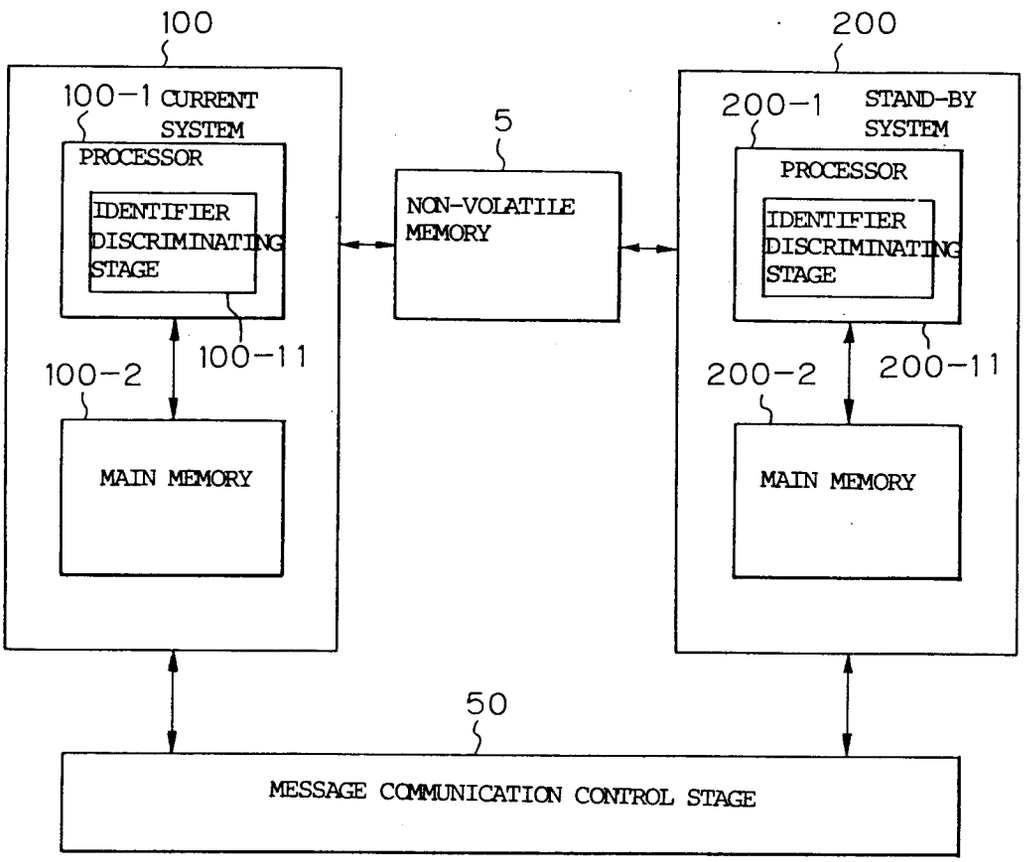

100
200
100-1 CURRENT SYSTEM
PROCESSOR
IDENTIFIER DISCRIMINATING STAGE
100-11
100-2
MAIN MEMORY
5
NON-VOLATILE MEMORY
200-1 STAND-BY SYSTEM
PROCESSOR
IDENTIFIER DISCRIMINATING STAGE
200-11
200-2
MAIN MEMORY
50
MESSAGE COMMUNICATION CONTROL STAGE

Fig. 20

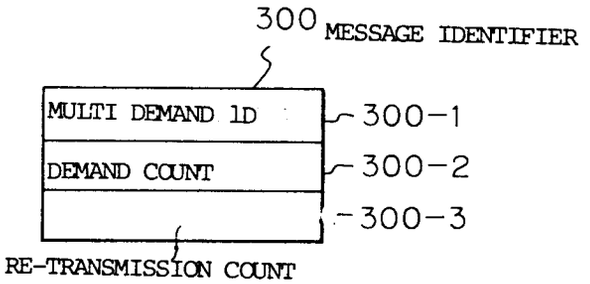

300 MESSAGE IDENTIFIER
MULTI DEMAND ID
300-1
DEMAND COUNT
300-2
300-3
RE-TRANSMISSION COUNT

Fig. 21

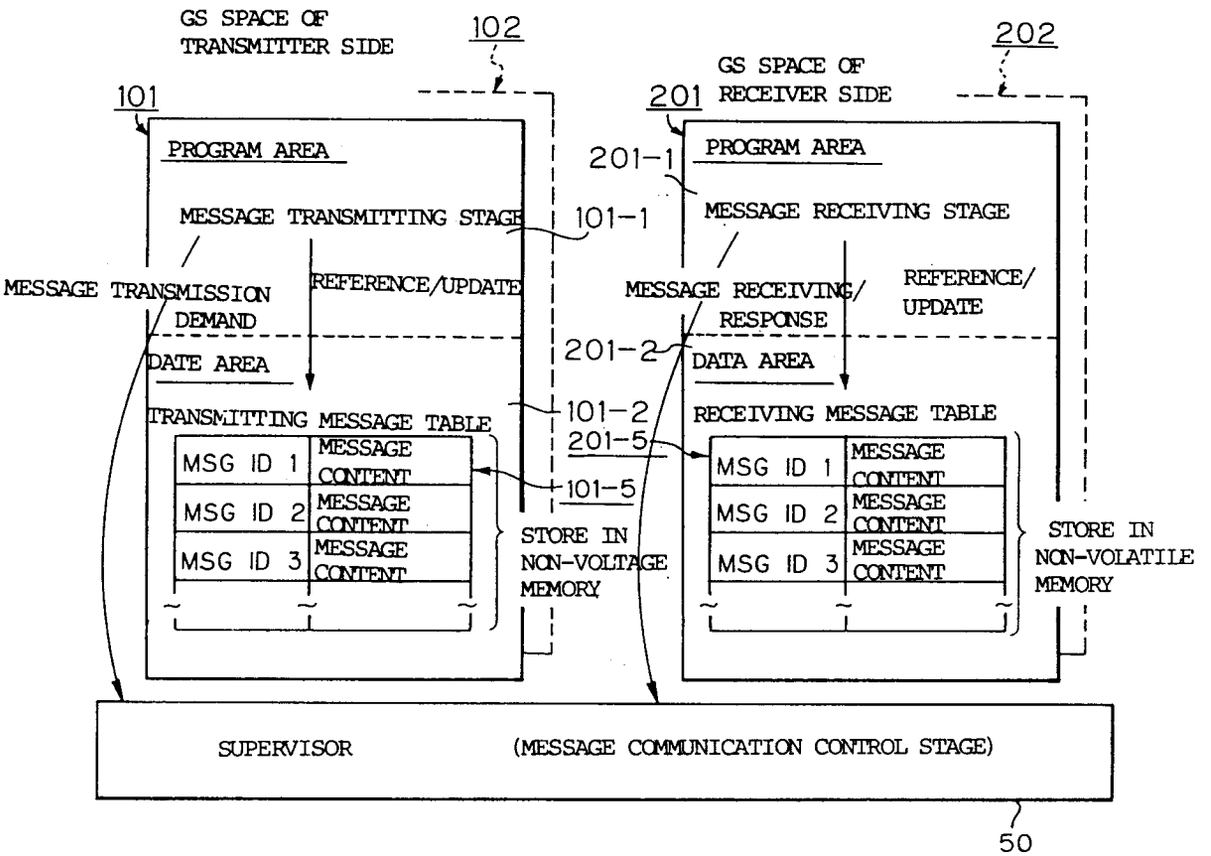

GS SPACE OF TRANSMITTER SIDE
102
101
PROGRAM AREA
MESSAGE TRANSMITTING STAGE
101-1
MESSAGE TRANSMISSION DEMAND
REFERENCE/UPDATE
DATE AREA
TRANSMITTING MESSAGE TABLE
101-2
MSG ID 1
MESSAGE CONTENT
MSG ID 2
MESSAGE CONTENT
MSG ID 3
MESSAGE CONTENT
101-5
STORE IN NON-VOLTAGE MEMORY
202
GS SPACE OF RECEIVER SIDE
201
201-1
PROGRAM AREA
MESSAGE RECEIVING STAGE
MESSAGE RECEIVING/ RESPONSE
REFERENCE/ UPDATE
201-2
DATA AREA
RECEIVING MESSAGE TABLE
201-5
MSG ID 1
MESSAGE CONTENT
MSG ID 2
MESSAGE CONTENT
MSG ID 3
MESSAGE CONTENT
STORE IN NON-VOLATILE MEMORY
SUPERVISOR
(MESSAGE COMMUNICATION CONTROL STAGE)
50

Fig. 22

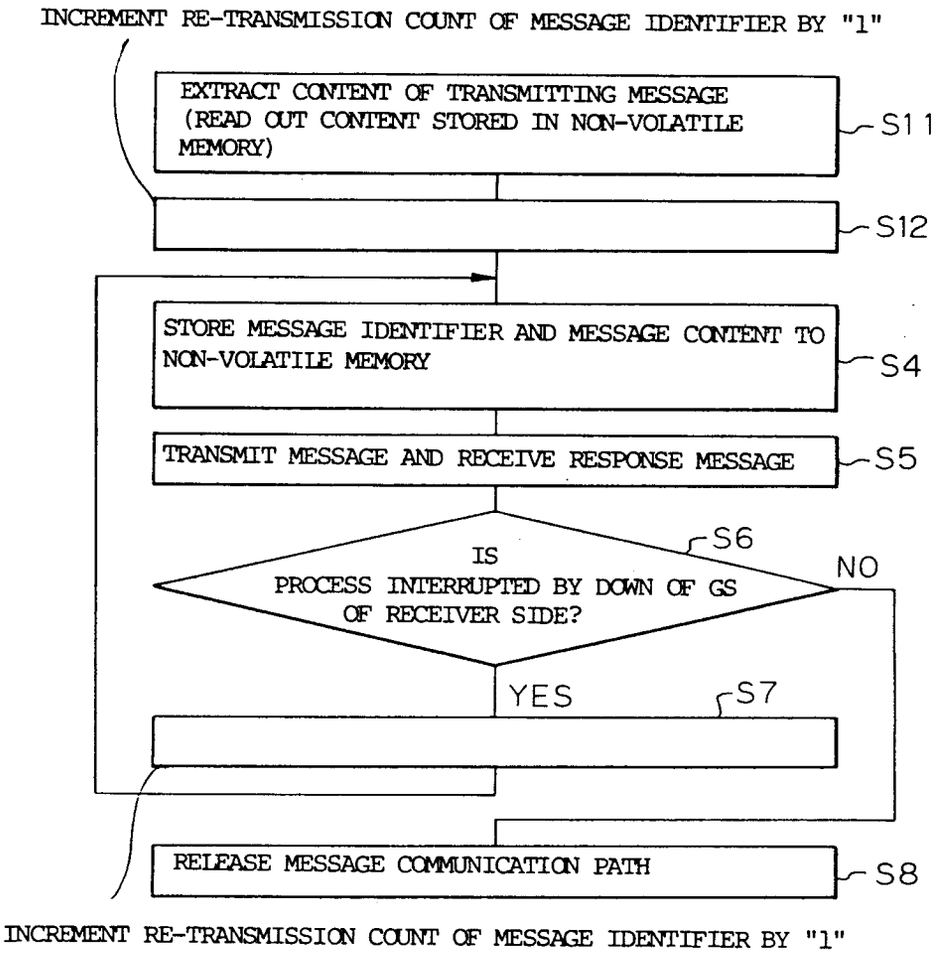

INCREMENT RE-TRANSMISSION COUNT OF MESSAGE IDENTIFIER BY "1"
EXTRACT CONTENT OF TRANSMITTING MESSAGE (READ OUT CONTENT STORED IN NON-VOLATILE MEMORY)
S11
S12
STORE MESSAGE IDENTIFIER AND MESSAGE CONTENT TO NON-VOLATILE MEMORY
S4
TRANSMIT MESSAGE AND RECEIVE RESPONSE MESSAGE
S5
IS PROCESS INTERRUPTED BY DOWN OF GS OF RECEIVER SIDE?
S6
NO
YES
S7
RELEASE MESSAGE COMMUNICATION PATH
S8
INCREMENT RE-TRANSMISSION COUNT OF MESSAGE IDENTIFIER BY "1"

Fig. 23

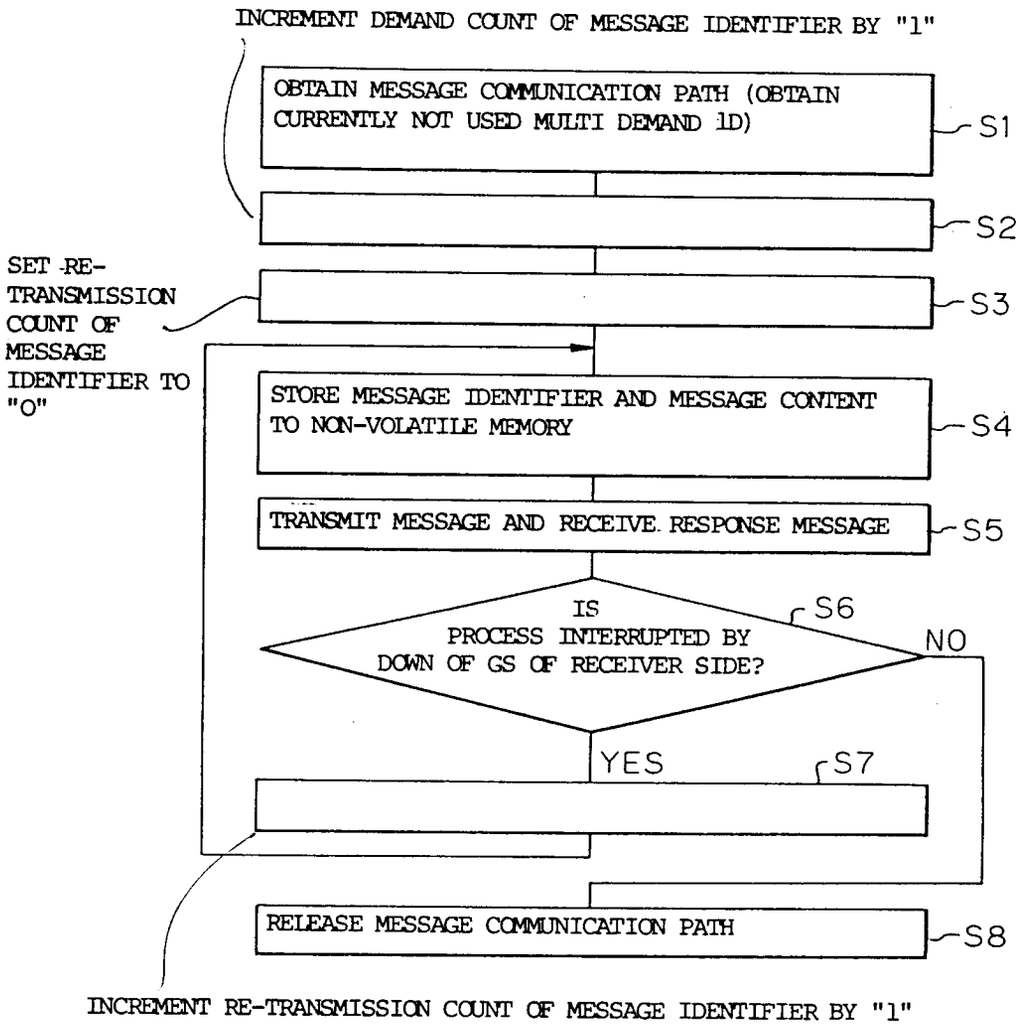
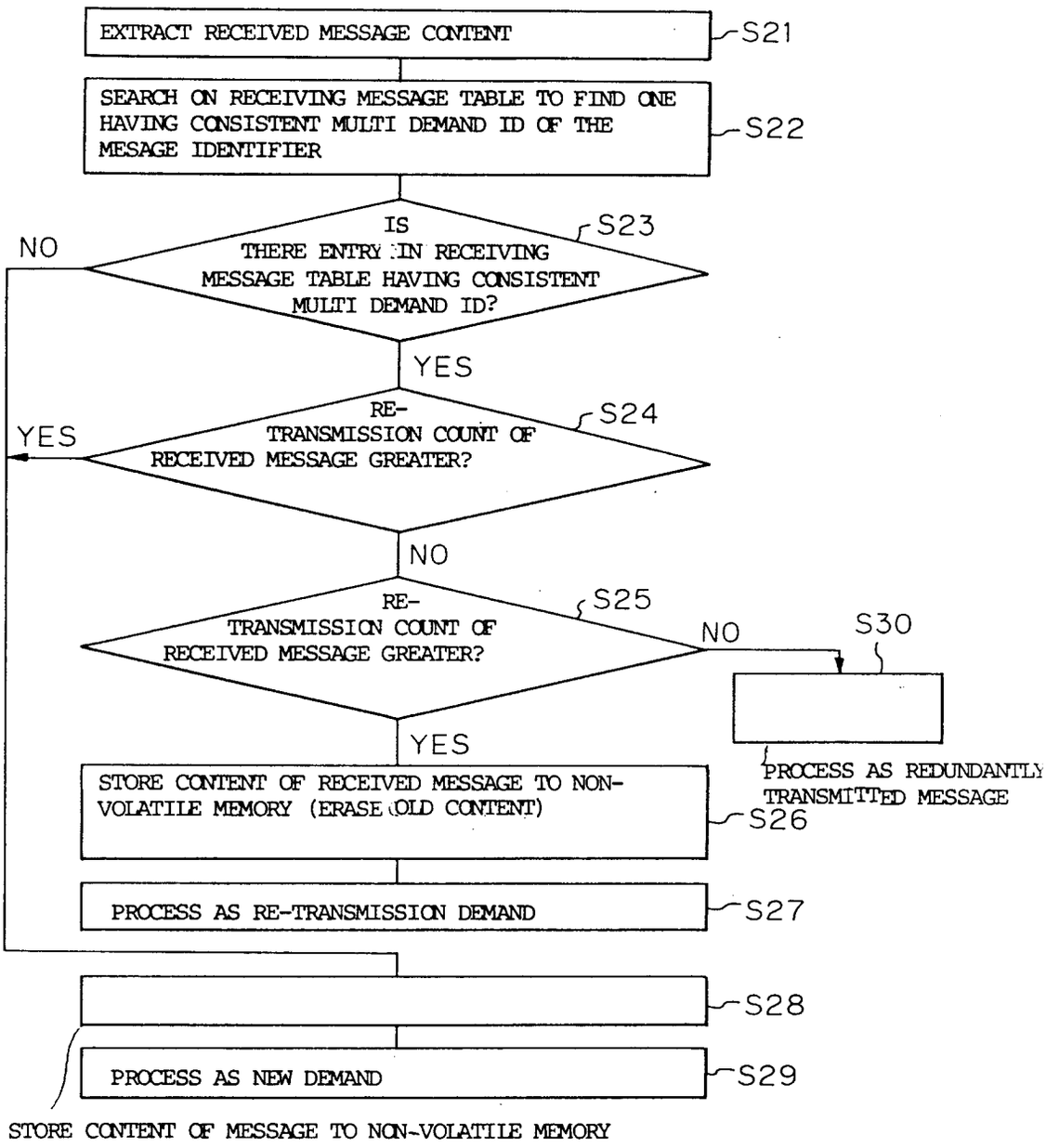

INCREMENT DEMAND COUNT OF MESSAGE IDENTIFIER BY "1"
OBTAIN MESSAGE COMMUNICATION PATH (OBTAIN CURRENTLY NOT USED MULTI DEMAND ID)
S1
S2
SET RE-TRANSMISSION COUNT OF MESSAGE IDENTIFIER TO "0"
S3
STORE MESSAGE IDENTIFIER AND MESSAGE CONTENT TO NON-VOLATILE MEMORY
S4
TRANSMIT MESSAGE AND RECEIVE RESPONSE MESSAGE
S5
IS PROCESS INTERRUPTED BY DOWN OF GS OF RECEIVER SIDE?
S6
NO
YES
S7
RELEASE MESSAGE COMMUNICATION PATH
S8
INCREMENT RE-TRANSMISSION COUNT OF MESSAGE IDENTIFIER BY "1"

Fig. 24


EXTRACT RECEIVED MESSAGE CONTENT
S21
SEARCH ON RECEIVING MESSAGE TABLE TO FIND ONE HAVING CONSISTENT MULTI DEMAND ID OF THE MESAGE IDENTIFIER
S22
IS THERE ENTRY IN RECEIVING MESSAGE TABLE HAVING CONSISTENT MULTI DEMAND ID?
S23
NO
YES
RE-TRANSMISSION COUNT OF RECEIVED MESSAGE GREATER?
S24
YES
NO
RE-TRANSMISSION COUNT OF RECEIVED MESSAGE GREATER?
S25
NO
S30
YES
PROCESS AS REDUNDANTLY TRANSMITTED MESSAGE
STORE CONTENT OF RECEIVED MESSAGE TO NON-VOLATILE MEMORY (ERASE OLD CONTENT)
S26
PROCESS AS RE-TRANSMISSION DEMAND
S27
S28
PROCESS AS NEW DEMAND
S29
STORE CONTENT OF MESSAGE TO NON-VOLATILE MEMORY

INTERNATIONAL SEARCH REPORT

International Application No PCT/JP91/00293

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[5] G06F15/16

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	G06F15/16, H04L12/40

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho 1971 - 1990
Kokai Jitsuyo Shinan Koho 1971 - 1990

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	JP, A, 1-166159 (Matsushita Electric Ind. Co., Ltd.), June 30, 1989 (30. 06. 89), Line 14, lower part, left column to line 18, lower part, right column, page 2 (Family: none)	1-5
Y	JP, A, 61-243559 (Yokogawa Hokushin Electric Corp.), October 29, 1986 (29. 10. 86), Line 10, lower part, right column, page 2 to line 15, upper part, left column, page 3 (Family: none)	1-5
Y	JP, A, 62-280955 (Fujitsu Ltd.), December 5, 1987 (05. 12. 87), Line 2, lower part, right column, page 2 to line 14, upper part, right column, page 3 (Family: none)	1-5
Y	JP, A, 63-211451 (Fujitsu Ltd.), September 2, 1988 (02. 09. 88), Line 6, upper part, right column to	1-5

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
May 1, 1991 (01. 05. 91)	May 20, 1991 (20. 05. 91)
International Searching Authority	**Signature of Authorized Officer**
Japanese Patent Office	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

line 2, lower part, left column, page 2
(Family: none)

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers , because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim numbers , because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.